



Cornell University

Announcements

Graduate School of  
Medical Sciences

1970-71



Cornell University

Graduate School of  
Medical Sciences

1970-71

1300 York Avenue

New York, New York 10021

Telephone: 212/879-7379 or 879-9000, ext. 8108

## Calendar\*

### FALL SEMESTER

1970-71

Registration	Sept. 9, 10, 11
Opening Exercises, 3:30 p.m.	Sept. 11
Instruction begins for first trimester and fall semester	Sept. 14
Fall recess	Oct. 26-Nov. 3
End of first trimester	Nov. 25
Thanksgiving recess	Nov. 26-27
Examinations for first trimester	Dec. 9-15
Instruction begins for second trimester	Dec. 16
Christmas recess:	
Instruction suspended, 5:00 p.m.	Dec. 22
Instruction resumed, 9:00 a.m.	Jan. 4
Last day for completing all requirements for January degrees	Jan. 8
Fall semester ends	Jan. 30

### SPRING SEMESTER

Registration	Feb. 1
Instruction begins for spring semester	Feb. 1
End of second trimester	Mar. 12
Examinations for second trimester	Mar. 15-24
Instruction begins for third trimester	Mar. 29
Spring recess:	
Instruction suspended, 5:00 p.m.	Apr. 11
Instruction resumed, 9:00 a.m.	Apr. 18
Last day for completing all requirements for June degrees	May 24
Memorial Day, holiday	May 31
Commencement, 3:00 p.m.	June 1
End of third trimester and spring semester	June 11
Examinations for third trimester	June 14-15

### SUMMER

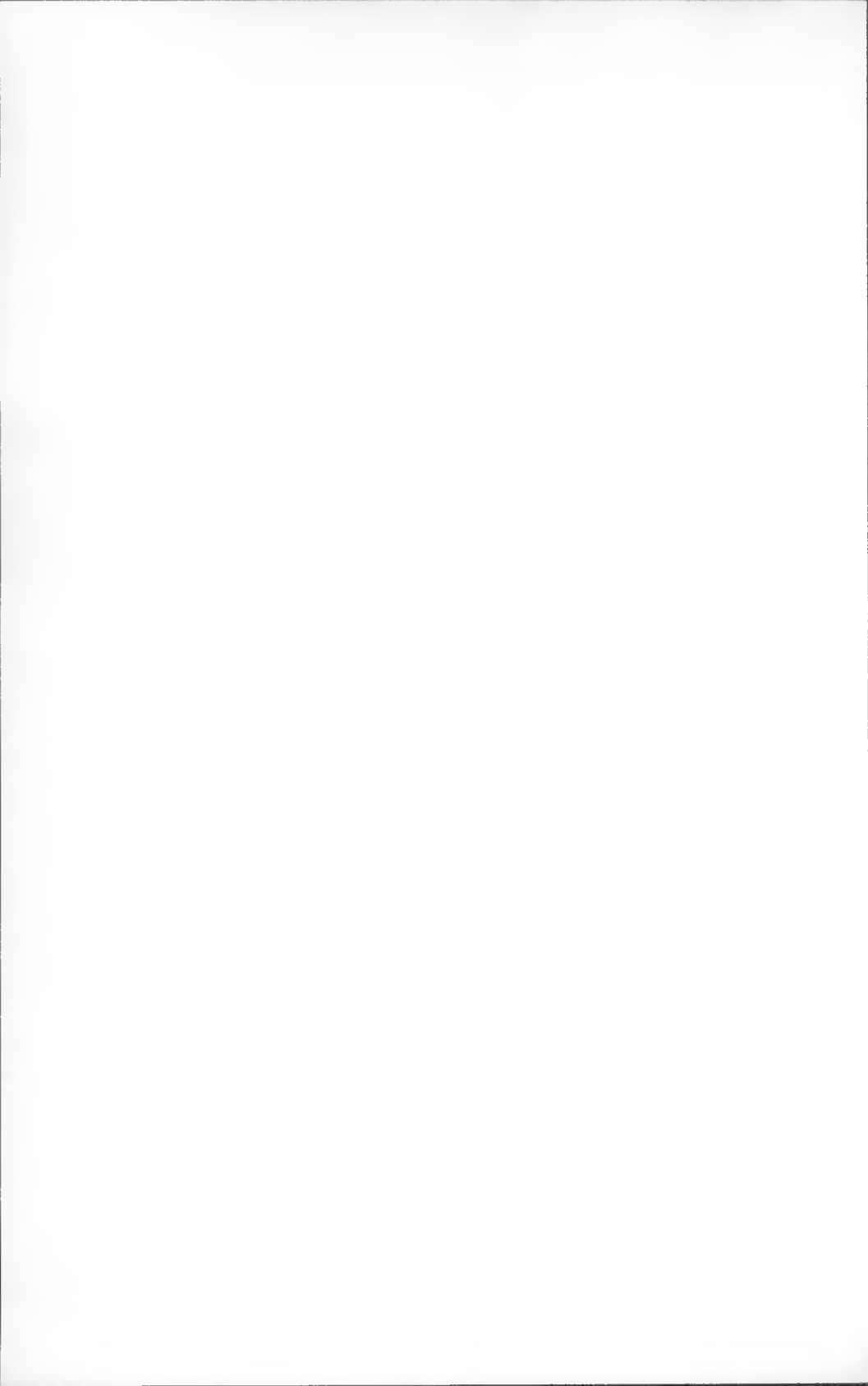
Summer research period begins	June 16
Registration for summer research	June 16
Last day for completing all requirements for September degrees	Aug. 30
Labor Day, holiday	Sept. 6
Summer research period ends	Sept. 10

\* Courses in the Graduate School of Medical Sciences are either semestral or trimestral. The calendar for this School is based primarily on the academic semester but is coordinated as well with the trimestral calendar of the Medical College.

## Contents

5	ADMINISTRATION AND FACULTY
11	GRADUATE SCHOOL OF MEDICAL SCIENCES
11	PURPOSE AND NATURE OF GRADUATE STUDY
11	GRADUATE SCHOOL HISTORY
12	FACILITIES
12	ORGANIZATION OF THE SCHOOL
13	ADMISSION
14	DEGREE REQUIREMENTS
18	TUITION AND FEES
18	FINANCIAL ASSISTANCE
19	STUDENT HEALTH SERVICE
20	FIELDS OF INSTRUCTION
20	INSTRUCTION AT THE MEDICAL COLLEGE DIVISION
34	INTERDIVISIONAL COURSES
35	INSTRUCTION AT THE SLOAN-KETTERING DIVISION
38	SPECIAL PROGRAMS
40	REGISTER OF STUDENTS
43	INDEX

The courses and curricula described in this *Announcement*, and the teaching personnel listed herein, are subject to change at any time by official action of Cornell University.



# Graduate School of Medical Sciences

## University Administration

Dale R. Corson, President of the University  
Robert A. Plane, University Provost  
Mark Barlow, Jr., Vice President for Student Affairs  
Lisle C. Carter, Jr., Vice President for Social and Environmental Studies  
W. Donald Cooke, Vice President for Research  
Lewis H. Durland, University Treasurer  
W. Keith Kennedy, Vice Provost  
Samuel A. Lawrence, Vice President for Administration  
E. Hugh Luckey, Vice President for Medical Affairs  
Thomas W. Mackesey, Vice President for Planning  
Paul L. McKeegan, Director of the Budget  
Robert D. Miller, Dean of the University Faculty  
Steven Muller, Vice President for Public Affairs  
Arthur H. Peterson, University Controller  
Neal R. Stamp, Secretary of the Corporation and University Counsel

## Officers of Administration of the Graduate School of Medical Sciences

Dale R. Corson, President of the University	Julian R. Rachele, Associate Dean of the Graduate School of Medical Sciences;
E. Hugh Luckey, Vice President for Medical Affairs	Assistant Dean of the Graduate School
W. Donald Cooke, Dean of the Graduate School	Frank L. Horsfall, Jr., Director, Sloan-Kettering Division
Thomas H. Meikle, Jr., Dean of the Graduate School of Medical Sciences; Associate Dean of the Graduate School	Frederick S. Philips, Associate Director, Sloan-Kettering Division

## Faculty

### Professors

M. Earl Balis, Professor of Biochemistry. B.A. 1943, Temple University; Ph.D. 1949, University of Pennsylvania.	Frank W. Foote, Jr., Professor of Pathology. B.A. 1931, M.D. 1935, University of Virginia.
Aaron Bendich, Professor of Biochemistry. B.S. 1939, City College of New York; Ph.D. 1946, Columbia University.	Jack J. Fox, Professor of Biochemistry. A.B. 1939, Ph.D. 1950, University of Colorado.
Oscar Bodansky, Professor of Biochemistry. M.A. 1922, Ph.D. 1925, Columbia University; M.D. 1938, University of Chicago.	Sanford Goldstone, Professor of Psychology in Psychiatry. B.S. 1947, City College of New York; Ph.D. 1953, Duke University.
Edward A. Boyse, Professor of Biology. B.S. 1952, M.D. 1957, University of London.	Peter J. Gomatos, Professor of Microbiology. S.B. 1950, Massachusetts Institute of Technology; M.D. 1954, Johns Hopkins University; Ph.D. 1963, Rockefeller University.
George B. Brown, Professor of Biochemistry. B.S. 1934, Illinois Wesleyan University; Ph.D. 1938, University of Illinois.	Roger L. Greif, Professor of Physiology and Biophysics. B.S. 1937, Haverford College; M.D. 1941, Johns Hopkins University.
John J. Burns, Visiting Professor of Pharmacology. B.S. 1942, Queens College; M.A. 1948, Ph.D. 1950, Columbia University.	Milton Helpern, Visiting Professor of Pathology. B.S. 1922, City College of New York; M.D. 1926, Cornell University.
Liebe F. Cavalieri, Professor of Biochemistry. B.S. 1943, Ph.D. 1945, University of Pennsylvania.	Frank L. Horsfall, Jr., Professor of Microbiology. B.A. 1927, University of Washington; M.D. 1932, McGill University; Ph.D. 1961, Upsala University.
Etienne P. De Harven, Professor of Biology. M.D. 1953, Universite Libre de Bruxelles.	Dorris J. Hutchison, Professor of Microbiology. B.S. 1940, Western Kentucky State College; Ph.D. 1949, Rutgers University.
John T. Ellis, Professor of Pathology. B.A. 1942, University of Texas; M.D. 1945, Northwestern University.	Kenneth G. Johnson, Professor of Public Health in Community Medicine. B.S. 1944, Manhattan College; M.D. 1950, State University of New York (New York City).
Edward R. Epp, Professor of Biophysics. B.A. 1950, University of Saskatchewan; Ph.D. 1955, McGill University.	

## 6 Faculty

- Aaron Kellner, Clinical Professor of Pathology. B.A. 1934, Yeshiva College; M.S. 1936, Columbia University; M.D. 1939, University of Chicago.
- John G. Kidd, Professor of Pathology. A.B. 1928, Duke University; M.D. 1932, Johns Hopkins University.
- John S. Laughlin, Professor of Biophysics. A.B. 1940, Williamette University; Ph.D. 1947, University of Illinois.
- Joel L. Lebowitz, Visiting Professor of Biomathematics. B.S. 1952, Brooklyn College; M.S. 1955, Ph.D. 1956, Syracuse University.
- John Macleod, Professor of Anatomy. A.B. 1934, M.Sc. 1937, New York University; Ph.D. 1941, Cornell University.
- Walsh McDermott, Livingston Farrand Professor of Public Health. A.B. 1930, Princeton University; M.D. 1934, Columbia University.
- Alton Meister, Israel Rogosin Professor of Biochemistry. S.B. 1942, Harvard University; M.D. 1945, Cornell University.
- Robert C. Mellors, Professor of Pathology. A.B. 1937, M.A. 1938, Ph.D. 1940, Western Reserve University; M.D. 1944, Johns Hopkins University.
- Walter Modell, Professor of Pharmacology. B.S. 1928, City College of New York; M.D. 1932, Cornell University.
- George E. Murphy, Professor of Pathology. A.B. 1939, University of Kansas; M.D. 1943, University of Pennsylvania.
- Lloyd J. Old, Professor of Biology. B.A. 1955, M.D. 1958, University of California.
- Mary L. Petermann, Professor of Biology. A.B. 1929, Smith College; Ph.D. 1939, University of Wisconsin.
- Frederick S. Philips, Professor of Pharmacology. B.A. 1936, Columbia University; Ph.D. 1940, University of Rochester.
- Robert F. Pitts, Maxwell M. Upson Professor of Physiology and Biophysics. B.S. 1929, Butler University; Ph.D. 1932, Johns Hopkins University; M.D. 1938, New York University.
- Aaron S. Posner, Professor of Biochemistry. B.S. 1941, Rutgers University; M.S. 1949, Polytechnic Institute of Brooklyn; Ph.D. 1954, University of Liege.
- Julian R. Rachele, Professor of Biochemistry. B.A. 1934, M.S. 1935, Ph.D. 1939, New York University.
- Walter F. Riker, Jr., Professor of Pharmacology. B.S. 1939, Columbia University; M.D. 1943, Cornell University.
- Albert L. Rubin, Professor of Biochemistry. M.D. 1950, Cornell University.
- Sol I. Rubinow, Professor of Biomathematics. B.S. 1944, City College of New York; M.S. 1947, Brown University; Ph.D. 1951, University of Pennsylvania.
- F. Kingsley Sanders, Professor of Cell Biology. B.A. 1939, Ph.D. 1942, Oxford University.
- William F. Scherer, Professor of Microbiology. M.D. 1947, University of Rochester.
- William N. Schoenfeld, Clinical Professor of Psychology in Psychiatry. B.S. 1937, City College of New York; A.M. 1939, Ph.D. 1942, Columbia University.
- Martin Sonenberg, Professor of Biochemistry. B.S. 1941, University of Pennsylvania; M.D. 1944, Ph.D. 1952, New York University.
- C. Chester Stock, Professor of Biochemistry. B.S. 1932, Rose Polytechnic Institute; Ph.D. 1937, Johns Hopkins University.
- Roy C. Swan, Joseph C. Hinsey Professor of Anatomy. A.B. 1941, M.D. 1947, Cornell University.
- Erich H. Windhager, Professor of Physiology. M.D. 1954, University of Vienna.
- Myron Winick, Professor of Pediatrics. A.B. 1951, Columbia University; M.S. 1952, University of Illinois; M.D. 1956, State University of New York (Brooklyn).

## Associate Professors

- Amir Askari, Associate Professor of Pharmacology. B.S. 1953, University of Dubuque; M.S. 1956, New York University; Ph.D. 1960, Cornell University.
- Sulamita Balagura-Baruch, Associate Professor of Physiology. M.D. 1959, University del Valle.
- Carl G. Becker, Associate Professor of Pathology. B.S. 1957, Yale University; M.D. 1961, Cornell University.
- Dorothea Bennett, Associate Professor of Anatomy. A.B. 1951, Barnard College; Ph.D. 1956, Columbia University.
- William A. Briscoe, Associate Professor of Medicine. B.A. 1939, M.A. 1941, B.M., B.Ch. 1942, D.M. 1951, Oxford University.
- Roy W. Bonsnes, Associate Professor of Biochemistry. B.S. 1930, University of Connecticut; Ph.D. 1939, Yale University.
- Ellen Borenfreund, Associate Professor of Biochemistry. B.S. 1946, Hunter College; Ph.D. 1957, New York University.
- Dana C. Brooks, Associate Professor of Anatomy. B.E.E. 1949, M.D. 1957, Cornell University.
- Walter W.Y. Chan, Associate Professor of Pharmacology. B.A. 1956, University of Wisconsin; Ph.D. 1961, Columbia University.
- M. Renate Dische, Clinical Associate Professor of Pathology. B.S. 1941, Immaculata College; Ph.D. 1953, M.D. 1957, Columbia University.
- Betty J. Flehinger, Visiting Associate Professor of Biomathematics. A.B. 1941, Barnard College; M.A. 1942, Cornell University; Ph.D. 1960, Columbia University.
- Jørgen E. Fogh, Associate Professor of Microbiology. M.D. 1949, University of Copenhagen.
- James L. German III, Clinical Associate Professor of Anatomy. B.S. 1945, Louisiana

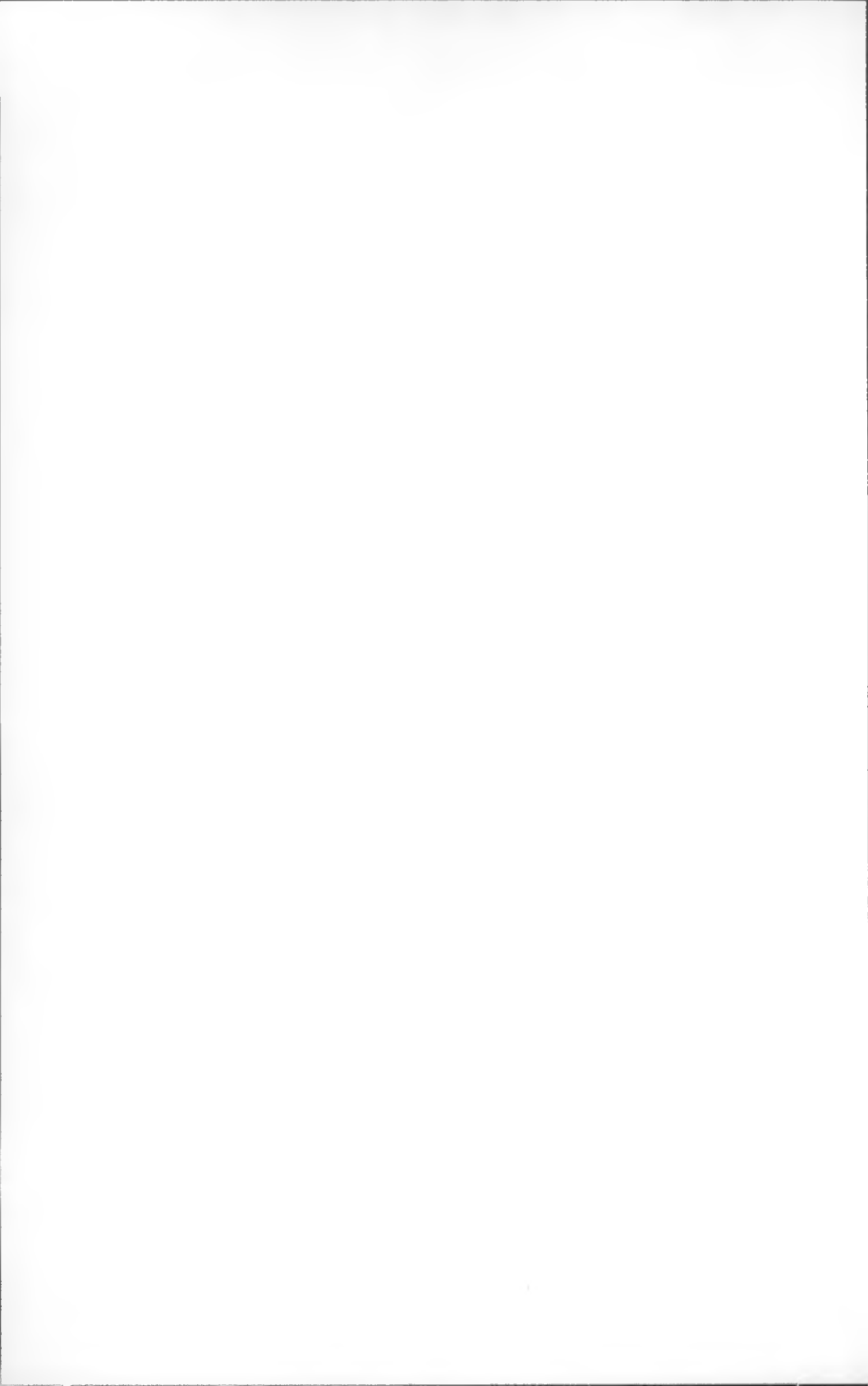


- Polytechnic Institute; M.D. 1949, Southwestern University.
- Michael D. Gershon, Associate Professor of Anatomy. B.A. 1958, M.D. 1963, Cornell University.
- Helena Gilder, Associate Professor of Biochemistry in Surgery; Assistant Professor of Biochemistry. A.B. 1935, Vassar College; M.D. 1940, Cornell University.
- Jack Goldstein, Associate Professor of Biochemistry. B.A. 1952, Brooklyn College; M.N.S. 1957, Ph.D. 1959, Cornell University.
- Bernice Grafstein, Associate Professor of Physiology. B.A. 1951, University of Toronto; Ph.D. 1954, McGill University.
- Saul Green, Associate Professor of Biochemistry. B.S. 1948, City College of New York; Ph.D. 1952, State University of Iowa.
- Stanley Gross, Clinical Associate Professor of Pathology. B.S. 1936, M.D. 1939, New York University.
- Wilbur D. Hagamen, Associate Professor of Anatomy. B.S. 1945, Baldwin-Wallace College; M.D. 1951, Cornell University.
- Eric W. Hahn, Associate Professor of Biophysics. B.S. 1954, University of Georgia; Ph.D. 1960, University of Illinois.
- Rudy H. Haschemeyer, Associate Professor of Biochemistry. B.A. 1952, Carthage College; Ph.D. 1957, University of Illinois.
- Harold G. Hempling, Associate Professor of Physiology and Biophysics. A.B. 1948, New York University; M.A. 1950, Oberlin College; Ph.D. 1953, Princeton University.
- Raymond W. Houde, Associate Professor of Pharmacology. A.B. 1940, M.D. 1943, New York University.
- Myron S. Jacobs, Clinical Associate Professor of Anatomy. B.A. 1945, University of Pennsylvania; M.S. 1951, Ph.D. 1955, New York University.
- Norman B. Javitt, Associate Professor of Medicine. A.B. 1947, Syracuse University; Ph.D. 1951, University of North Carolina; M.D. 1954, Duke University.
- Richard P. Kelisky, Visiting Associate Professor of Biomathematics. B.S. 1951, Texas Technological College; Ph.D. 1957, University of Texas.
- Leonhard Korngold, Associate Professor of Microbiology in Surgery (Orthopedics). B.A. 1947, Brooklyn College; M.Sc. 1948, Ph.D. 1950, Ohio State University.
- Leopold G. Koss, Associate Professor of Pathology. M.D. 1946, University of Berne.
- Willi Kreis, Associate Professor of Biochemistry. B.S. 1953, Ph.D. 1957, University of Basle; M.D. 1954, University of Zurich.
- Martin Lipkin, Associate Professor of Medicine. A.B. 1946, M.D. 1950, New York University.
- Donald W. R. Mackenzie, Associate Professor of Microbiology. B.Sc. 1953, Ph.D. 1958, Edinburgh University.
- Thomas H. Meikle, Jr., Associate Professor of Anatomy. A.B. 1951, M.D. 1954, Cornell University.
- C. Richard Minick, Associate Professor of Pathology. B.S. 1957, University of Wyoming; M.D. 1960, Cornell University.
- Jerome S. Nisselbaum, Associate Professor of Biochemistry. B.A. 1949, University of Connecticut; Ph.D. 1953, Tufts College.
- William M. O'Leary, Associate Professor of Microbiology. B.S. 1952, M.S. 1953, Ph.D. 1957, University of Pittsburgh.
- Alfred M. Prince, Clinical Associate Professor of Pathology. A.B. 1949, Yale University; M.A. 1951, Columbia University; M.D. 1955, Western Reserve University.
- Donald J. Reis, Associate Professor of Neurology. A.B. 1953, M.D. 1956, Cornell University.
- Charlotte Ressler, Associate Professor of Biochemistry. B.A. 1944, New York University; M.A. 1946, Ph.D. 1949, Columbia University.
- Barbara H. Rosenberg, Associate Professor of Biochemistry. B.S. 1950, Ph.D. 1962, Cornell University.
- Leonard Ross, Associate Professor of Anatomy. A.B. 1946, M.S. 1949, Ph.D. 1954, New York University.
- Charles A. Santos-Buch, Associate Professor of Pathology. A.B. 1953, Harvard University; M.D. 1957, Cornell University.
- Brij Saxena, Associate Professor of Biochemistry in Medicine. Ph.D. 1954, University of Lucknow; Dr. rer. nat. 1957, University of Munster; Ph.D. 1961, University of Wisconsin.
- Morton K. Schwartz, Associate Professor of Biochemistry. B.A. 1948, Lehigh University; Ph.D. 1952, Boston University.
- Laurence B. Senterfit, Associate Professor of Microbiology. B.S. 1949, M.S. 1950, University of Florida; Sc.D. 1955, Johns Hopkins University.
- John F. Seybolt, Clinical Associate Professor of Pathology. B.S. 1938, Yale University; M.D. 1943, Cornell University.
- Julio L. Sirlin, Associate Professor of Anatomy. D.Sc. 1953, University of Buenos Aires.
- Francis M. Sirotinak, Associate Professor of Microbiology. B.S. 1950, University of Scranton; Ph.D. 1954, University of Maryland.
- Gregory W. Siskind, Associate Professor of Medicine. B.A. 1955, Cornell University; M.D. 1959, New York University.
- Vladimir P. Skipski, Associate Professor of Biochemistry. M.S. 1938, Kiev University; Ph.D. 1956, University of Southern California.
- Gerard P. Smith, Associate Professor of Physiology in Psychiatry. B.S. 1956, St. Joseph's College; M.D. 1960, University of Pennsylvania.
- Leslie H. Sobin, Associate Professor of Pathology. B.S. 1955, Union College; M.D.

## 8 Faculty

- 1959, State University of New York (Brooklyn).
- Cyril Solomon, Clinical Associate Professor of Pathology. B.S. 1932, M.D. 1936, University of Maryland.
- Kurt H. Stenzel, Associate Professor of Biochemistry. B.A. 1954, New York University; M.D. 1958, Cornell University.
- Stephen S. Sternberg, Associate Professor of Pathology. B.A. 1941, Colby College; M.D. 1944, New York University.
- Alan Van Poznak, Clinical Associate Professor of Pharmacology. A.B. 1948, M.D. 1952, Cornell University.
- Leo Wade, Associate Professor of Preventive Medicine. A.B. 1933, M.D. 1938, Washington University.
- Daniel Wellner, Associate Professor of Biochemistry. A.B. 1956, Harvard University; Ph.D. 1961, Tufts University.
- Kenneth R. Woods, Associate Professor of Biochemistry. B.A. 1948, Arizona State University; Ph.D. 1955, University of Minnesota.
- Tai Te Wu, Associate Professor of Biomathematics. B.S. 1958, University of Illinois; S.M. 1959, Ph.D. 1961, Harvard University.
- Louis Zeitz, Associate Professor of Biophysics. A.B. 1948, University of California; Ph.D. 1962, Stanford University.
- Assistant Professors**
- Alberta M. Albrecht, Assistant Professor of Microbiology. B.S. 1951, Seton Hall College; Ph.D. 1961, Rutgers University.
- Nancy W. Alcock, Assistant Professor of Biochemistry. B.S. 1949, University of Tasmania; Ph.D. 1960, University of London.
- Vittorino M. Andreoli, Visiting Assistant Professor of Anatomy. B.S. 1960, Liceo. Scient. di Verona; M.D. 1966, University of Padua.
- June L. Biedler, Assistant Professor of Biology. A.B. 1947, Vassar College; Ph.D. 1959, Cornell University.
- Daniel A. Bloch, Assistant Professor of Biomathematics. B.S. 1963, Stanford University; Ph.D. 1967, Johns Hopkins University.
- Esther M. Breslow, Assistant Professor of Biochemistry. B.S. 1953, Cornell University; M.S. 1955, Ph.D. 1959, New York University.
- Peter Bullough, Assistant Professor of Pathology. M.D. 1956, Liverpool University.
- Arthur S. Carlson, Clinical Assistant Professor of Pathology. A.B. 1941, Brooklyn College; M.D. 1952, Cornell University.
- Margaret H. S. Clements, Assistant Professor of Pathology. B.A. 1951, M.B., B.Ch., B.A.O. 1956, Dublin University.
- Robert W. Dickerman, Assistant Professor of Microbiology. B.S. 1951, Cornell University; M.A. 1953, University of Arizona; Ph.D. 1961, University of Minnesota.
- George W. Dietz, Jr., Assistant Professor of Biochemistry. B.A. 1959, Williams College; Ph.D. 1965, Yale University.
- Bozidar Djordjevic, Assistant Professor of Biophysics. M.S. 1952, University of Belgrade; Ph.D. 1960, Rutgers University.
- Edward S. Essner, Assistant Professor of Biology. B.S. 1947, Long Island University; Ph.D. 1951, University of Pennsylvania.
- Gordon F. Fairclough, Assistant Professor of Biochemistry. B.A. 1960, Ph.D. 1966, Yale University.
- Colin Fell, Assistant Professor of Physiology. A.B. 1951, Antioch College; M.S. 1953, Ph.D. 1957, Wayne State University.
- Caleb E. Finch, Assistant Professor of Anatomy. B.S. 1961, Yale University; Ph.D. 1969, Rockefeller University.
- John D. Fissekis, Assistant Professor of Biochemistry. B.S. 1954, University of Athens; Ph.D. 1960, University of Texas.
- Martin Fleisher, Assistant Professor of Biochemistry. B.A. 1958, Harpur College; Ph.D. 1966, New York University.
- Erwin Fleissner, Assistant Professor of Microbiology. B.A. 1957, Yale University; Ph.D. 1963, Columbia University.
- Jerrold Fried, Assistant Professor of Biophysics. B.S. 1958, California Institute of Technology; Ph.D. 1964, Stanford University.
- Ludwig Geib, Assistant Professor of Comparative Pathology. D.V.M. 1957, Cornell University; M.V.Sc. 1959, University of Toronto.
- Alfredo Giner-Sorolla, Assistant Professor of Biochemistry. M.S. 1944, University of Valencia; Ph.D. 1958, Cornell University.
- Fakhry Girgis, Assistant Professor of Anatomy. M.B., B.Ch. 1949, Cairo University; Ph.D. 1957, Queen's University (Belfast).
- George F. Gray, Jr., Assistant Professor of Pathology. B.A. 1956, University of Texas; M.D., M.S. 1961, Baylor University.
- Martin D. Hamburg, Assistant Professor of Anatomy. B.A. 1965, New York University; Ph.D. 1969, University of Michigan.
- Mary G. Hamilton, Assistant Professor of Biochemistry. B.A. 1947, University of Buffalo; Ph.D. 1961, Cornell University.
- Arthur H. Hayes, Jr., Assistant Professor of Pharmacology. A.B. 1955, University of Santa Clara; M.A. 1957, Oxford University; M.D. 1964, Cornell University.
- S. Steven Hotta, Assistant Professor of Biochemistry. A.B. 1950, Ph.D. 1953, University of California; M.D. 1958, Johns Hopkins University.
- Charles E. Inturrisi, Assistant Professor of Pharmacology. B.S. 1962, University of Connecticut; M.S. 1965, Ph.D. 1967, Tulane University.
- Evelyn F. Keller, Visiting Assistant Professor of Biomathematics. B.A. 1957, Brandeis University; M.A. 1959, Radcliffe College; Ph.D. 1963, Harvard University.
- Levy Kopelovich, Assistant Professor of Bio-

- chemistry. B.S. 1958, Hebrew University; Ph.D. 1962, University of California.
- Robert M. Krug, Assistant Professor of Microbiology. B.A. 1961, Harvard University; Ph.D. 1966, Rockefeller University.
- John E. Lee, Clinical Assistant Professor of Anatomy. A.B. 1954, Princeton University; M.D. 1958, Duke University.
- John Lenard, Assistant Professor of Biochemistry. B.A. 1958, Ph.D. 1964, Cornell University.
- Roberto Levi, Assistant Professor of Pharmacology. M.D. 1960, University of Florence.
- Michael J. Lyons, Assistant Professor of Microbiology. B.Sc. 1953, M.Sc. 1954, National University of Ireland; Ph.D. 1958, University of Glasgow.
- Thomas M. Maack, Assistant Professor of Physiology. M.D. 1962, University of Sao Paulo.
- John P. Maher, Clinical Assistant Professor of Public Health. B.S. 1956, St. Peter's College; M.D. 1960, State University of New York (Brooklyn); M.P.H. 1968, Harvard University.
- Valerie Mike, Assistant Professor of Biomathematics. B.A. 1956, Manhattanville College; Ph.D. 1967, New York University.
- Wayne G. Monahan, Assistant Professor of Biophysics. B.S. 1963, Ph.D. 1968, Ohio State University.
- Harold Moroson, Assistant Professor of Biophysics. B.S. 1950, Columbia University; Ph.D. 1958, Polytechnic Institute of Brooklyn.
- Herbert F. Oetgen, Assistant Professor of Biology. M.D. 1951, University of Cologne.
- Michiko Okamoto, Assistant Professor of Pharmacology. B.S. 1954, Tokyo College of Pharmacy; M.S. 1957, Purdue University; Ph.D. 1964, Cornell University.
- James C. Parham II, Assistant Professor of Biochemistry. B.S. 1959, Bates College; Ph.D. 1963, Duke University.
- Lou Ann Pilkington, Assistant Professor of Physiology. M.S. 1959, Ph.D. 1961, University of Oklahoma.
- Robert Porro, Assistant Professor of Pathology. A.B. 1956, University of California; M.D. 1960, Duke University.
- Ira Pullman, Assistant Professor of Biophysics. B.S. 1941, Columbia University; Ph.D. 1953, University of Illinois.
- Robert Riggio, Assistant Professor of Biochemistry. B.A. 1954, Dartmouth College; M.D. 1958, New York University.
- Theodore Robertson, Clinical Assistant Professor of Pathology. B.S. 1939, M.D. 1943, Cornell University.
- Toby C. Rodman, Assistant Professor of Anatomy. B.S. 1937, Philadelphia College of Pharmacy and Science; M.S. 1961, Ph.D. 1963, New York University.
- Josephine Salser, Assistant Professor of Biochemistry. B.S. 1950, University of the Philippines; Ph.D. 1955, Radcliffe College.
- Edward T. Schubert, Assistant Professor of Biochemistry. B.S. 1949, M.S. 1952, Ph.D. 1959, Fordham University.
- Gabriel H. Schwartz, Assistant Professor of Biochemistry. A.B. 1958, Princeton University; M.D. 1962, Columbia University.
- George Stassa, Assistant Professor of Anatomy. A.B. 1956, M.D. 1960, Columbia University.
- Myron Susin, Assistant Professor of Pathology. B.A. 1956, Augustana College; M.D. 1960, University of Illinois.
- Dieter H. Sussdorf, Assistant Professor of Microbiology. B.A. 1952, University of Kansas City; Ph.D. 1956, University of Chicago.
- Norbert I. Swislocki, Assistant Professor of Biochemistry. B.A. 1956, Ph.D. 1964, University of California.
- Morris N. Teller, Assistant Professor of Biology. B.S. 1940, Brooklyn College; Ph.D. 1948, University of Minnesota.
- Roy S. Tilbury, Assistant Professor of Biophysics. B.S. 1955, London University; Ph.D. 1963, McGill University.
- Thomas E. Wagner, Assistant Professor of Biochemistry. A.B. 1964, Princeton University; Ph.D. 1966, Northwestern University.
- Carolyn W. Watson, Clinical Assistant Professor of Pathology. B.A. 1945, Hollins College; M.D. 1949, University of Maryland.
- John Weber, Assistant Professor of Anatomy. B.A. 1961, D.D.S. 1965, Columbia University.
- Katsuhiko Yano, Assistant Professor of Public Health. M.D. 1951, Ph.D. 1961, Hiroshima Prefectural Medical College.
- Morris S. Zedeck, Assistant Professor of Pharmacology. B.S. 1961, Brooklyn College of Pharmacy; Ph.D. 1965, University of Michigan.



# Cornell University

## Graduate School of Medical Sciences

### Purpose and Nature of Graduate Study

The Graduate School of Medical Sciences, a semiautonomous component of the Graduate School of Cornell University, provides an environment for advanced study and research in specific areas of the basic biomedical sciences. Graduate programs leading to the degree of Doctor of Philosophy are currently offered in the Fields of Biochemistry, Biological Structure and Cell Biology, Biology, Biomathematics, Biophysics, Genetics, Microbiology, Neurobiology and Behavior, Pathology, Pharmacology, and Physiology. Certain of these Fields also offer programs leading to the degree of Master of Science. The Faculty recommends the award of advanced general degrees not only as the result of the fulfillment of certain formal academic requirements but also as evidence of the development and possession of a critical and creative ability in science. Proof of this ability is embodied in a dissertation which the candidate presents to the Faculty as an original research contribution in his area of study.

Freedom and independence are key qualities of scholarship, and graduate education at Cornell attempts to preserve them for teacher and student. Each graduate student is supervised by his own Special Committee, a small group of faculty members selected by the student. Within the broad framework provided by requirements for residence, examinations and thesis, and additional regulations of individual Fields, the Cornell graduate student and his Special Committee are completely free to plan a program of study. The Graduate School of Medical Sciences sets no overall course, credit-hour, or grade requirements. The Special Committee has extraordinary independence in guiding the student's program, and the student will be recommended for his degree whenever his Special Committee judges him qualified.

### History

The opportunity for graduate study leading to advanced general degrees in the biomedical sciences was first offered at the Cornell University

## 12 Organization

Medical College in 1912 in cooperation with the Graduate School of Cornell University. In June of 1950, Cornell University, in association with the Sloan-Kettering Institute for Cancer Research, established a new division of the Medical College, the Sloan-Kettering Division, for the purpose of providing additional opportunities for graduate study in the biomedical sciences. The resultant expansion of the Graduate Faculty and facilities on the New York City campus prompted the organization in January, 1952, of the Graduate School of Medical Sciences which, with the annual approval of the Graduate Faculty of Cornell University, has full responsibility for advanced general degrees granted for study in residence at the New York City campus.

### Facilities

**The Medical College Division:** The buildings of the Medical College extend along York Avenue from 68th to 70th Streets and contain the main library, lecture rooms and study laboratories for the basic science departments, and extensive research facilities for faculty and students.

**The Sloan-Kettering Division:** The facilities of the Sloan-Kettering Division consist of the Howard Laboratory and the Kettering Laboratory on East 68th Street in New York City and the Walker Laboratory in Rye, New York. These facilities of the Sloan-Kettering Institute for Cancer Research provide lecture and seminar rooms and well-equipped laboratories for biomedical research.

## Organization of the Graduate School

### Faculty

The Graduate School of Medical Sciences is composed of two relatively separate divisions, the Medical College Division, consisting principally of the professorial staff of the basic science departments of the Cornell University Medical College, and the Sloan-Kettering Division, consisting of the professorial staff of the Sloan-Kettering Institute for Cancer Research. Within each of these divisions are Fields or Units of graduate instruction formed by faculty members with similar research and teaching interests. An individual faculty member may elect to affiliate with the one or two Fields or Units in which he agrees to sponsor graduate students.

### General Committee

The General Committee of the Graduate School of Medical Sciences is an administrative board whose membership has responsibility for the academic affairs of the School. The Committee considers matters referred to it by members of the faculty and offers recommendations to the faculty on questions involving the interests or policies of the Graduate School of Medical Sciences.

The General Committee is composed of the dean and the associate dean of the Graduate School of Medical Sciences, the associate director of the

Sloan-Kettering Division, and one elected representative from each of the Fields of the Medical College Division and from each of the Units of the Sloan-Kettering Division. The General Committee approves new Fields; reviews the admission of students; approves major and minor subjects; reviews the curriculum of each Field; reviews the requirements for degrees; and acts on faculty and student petitions.

The chairman of the General Committee is the dean, who is the academic administrative officer of the Graduate School of Medical Sciences and is also an associate dean of the Graduate School of Cornell University. The secretary of the General Committee is the associate dean, who is also an assistant dean of the Graduate School of Cornell University.

## Admission

### Applications

For admission to the Graduate School of Medical Sciences an applicant must (1) have a baccalaureate degree or the equivalent from a college or university of recognized standing, (2) have adequate preparation in his chosen field of study, and (3) show promise of ability to pursue advanced study and research, as judged by his previous record.

Candidates may be admitted in September, February, or July. All credentials must be received at least two months prior to enrollment and the complete application and all supporting credentials must have been approved by the Dean at least one month prior to enrollment.

Inquiries about graduate study should be addressed to the Associate Dean of the Graduate School of Medical Sciences, 1300 York Avenue, New York, New York 10021 or to the Associate Director of the Sloan-Kettering Division, 444 East 68th Street, New York, N. Y. 10021. These inquiries are referred to the appropriate Field Representative(s) or Unit Chairman who then corresponds directly with the prospective applicant and sends him pertinent application material. The applicant returns the completed application form to the Field Representative together with (1) official transcripts of records from all colleges and universities attended, (2) a statement of purpose of graduate study, and (3) two letters of recommendation from individuals in academic positions who know the applicant professionally. In addition, scores from the Graduate Record Examinations may be required by individual Fields to aid in evaluating an applicant.

The completed application and all supporting documents are reviewed by the Field or Division Credentials Committee and applicants considered potentially acceptable are usually called for a personal interview. At the time of interview, after discussing his interests with the members of the Field, the applicant may tentatively select a major sponsor. If an applicant is accepted by the Field, his application is forwarded to the Dean who may refer it to the General Committee for final review and decision. A student is formally notified of his acceptance for study in the Graduate School of Medical Sciences by a letter from the associate dean.

## **14 Degree Requirements**

It is the policy of Cornell University actively to support the American ideal of equality of opportunity for all, and no student shall be denied admission or be otherwise discriminated against because of race, color, creed, religion, or national origin.

### **Categories of Admission**

An applicant is accepted by the Graduate School of Medical Sciences (1) as a degree candidate for the M.S. or Ph.D., or (2) as a provisional candidate.

Provisional candidacy provides opportunity for a prospective degree candidate, whose educational preparation is difficult to evaluate, to begin graduate studies. On the basis of the record of accomplishment in the first half of the academic year, the adviser or temporary Special Committee of a provisional candidate may recommend to the Dean that (1) provisional candidacy be changed to degree candidacy, (2) provisional candidacy be continued for the remainder of the academic year, or (3) provisional candidacy be terminated. A maximum of one academic year in the status of provisional candidate is permitted and credit of a maximum of one residence unit may be allowed on petition, provided there is convincing evidence that performance has been of the same quality as would have been required of a degree candidate.

## **Degree Requirements**

### **Major and Minor Subjects**

The faculty members of each Field specify major and minor subjects of study for fulfillment of the requirements for the degrees of Master of Science and Doctor of Philosophy. A candidate for the degree of Master of Science is required to register for one major and one minor subject. A candidate for the degree of Doctor of Philosophy is required to register for three subjects, one major and two minors. At least one of the candidate's minors must be outside the area of his major subject.

### **The Special Committee**

The general degree requirements of the Graduate School of Medical Sciences are minimal in order to give maximal flexibility in choosing a desirable program of study. The student's program is determined with the aid and direction of a Special Committee of faculty members chosen by the student from those Fields which best fit his areas of interest. Satisfactory progress toward the degree is judged by the Special Committee rather than by arbitrary standards imposed by the Graduate School of Medical Sciences. There are no regulations of the Faculty of the Graduate School of Medical Sciences governing the specific content of instruction, courses, or grades to which the Special Committee must subscribe, except those imposed by the Fields. The Special Committee is the agent primarily responsible for the candidate's development as an independent scholar and scientist.



No later than four weeks after enrollment, a candidate must file a statement of the major and minor subjects he has selected for study. After selecting his major and minor subjects, the student must choose one member of the faculty to represent each subject and to serve on his Special Committee. The faculty member representing the major subject usually advises the student in his other selections and serves as the chairman of his Special Committee. At least one member of the Special Committee must represent a Field different from the candidate's major Field. Members of a Special Committee may agree to serve temporarily during the candidate's first year of residence until he has had opportunity to become acquainted with areas of research in the Fields of his choice. On completion of this year of residence, a permanent Special Committee will be formed. The membership of a Special Committee can be changed with agreement of all members of the old and the newly formed Committees and the approval of the dean.

The members of the Special Committee decide upon the student's program of study and research and judge whether his progress toward a degree is satisfactory. After consulting with the other members, the chairman of the Special Committee prepares term reports on the candidate for submission to the dean. The members of the Committee serve on all of the candidate's examining committees and they approve his thesis.

### Registration and Course Grades

At the beginning of each term, the student is required to register with the dean of the Graduate School of Medical Sciences and to file a Registration of Courses form indicating all courses he will take. A fee of ten dollars is charged for late registration. No student may double-register for an advanced general or professional degree with any other school or college except the Cornell University Medical College.

All courses for which the student registers for credit will be entered in his official record. Grades of graduate students are reported as: Excellent (E), Satisfactory (S), Unsatisfactory (U), Incomplete (I), Absent (Abs), or Unofficially Withdrawn (W). A grade of Incomplete or Absent cannot be changed later than one term following that in which the course was taken.

### Residence

The Faculty of the Graduate School of Medical Sciences regards study in residence as essential. Full-time study for one half academic year with satisfactory accomplishment constitutes one residence unit. Two units of residence are the minimal requirement for the Master's degree and six units are the minimum for the Ph.D. degree. However, the time necessary to obtain the degree generally exceeds the minimal requirements. A candidate for the Ph.D. degree must spend two of the last four units of required residence in successive terms on the New York City or the Ithaca campus of Cornell University. No more than seven years may intervene between the time of first registration and the completion of all requirements for the doctoral degree; a student must complete all requirements for the Master's degree in four years.

## 16 Residence

The graduate student who participates in teaching or assists in research qualifies for full residence credit only if his duties are in the field of his major subject and do not require more than twenty hours per week. Part-time graduate study, if it is necessitated by off-campus employment non-contributory to the major field of study, is not encouraged. Requests for part-time study must be reviewed by the General Committee. If permission is granted for part-time study, the student must be in residence at least half-time.

The legislation with respect to eligibility of part-time students for residence units is as follows:

Employment	Residence Units Allowable Per Half Academic Year		
Total clock-hrs. per week	Contributory in the major field of study and on campus	Noncontributory but on campus	Off campus
0-10 hrs.	1 unit	1 unit	$\frac{3}{4}$ unit
11-20 hrs.	1 unit	$\frac{3}{4}$ unit	1 unit
21-30 hrs.	$\frac{3}{4}$ unit (teaching) $\frac{3}{4}$ -1 unit (research)*	$\frac{1}{2}$ unit	—

\* Time spent assisting in research, if it is contributory to the major field of study, shall be credited toward allowance of a full residence unit.

### Transfer of Residence Credit

No residence credit will be granted for study outside the Graduate School of Medical Sciences to fulfill the requirements of the M.S. degree. No commitment can be made about granting residence credit toward the Ph.D. requirements for previous study in another graduate school until after the candidate has entered into residence at the Graduate School of Medical Sciences. At that time, the student's Special Committee may recommend acceptance of study outside the Graduate School of Medical Sciences to the General Committee which will determine the number of residence units to be awarded. In general, a maximum of two units may be transferred, but the dean may approve acceptance of a maximum of three units and, on petition, the General Committee may approve a maximum of four units. No credit can be transferred for study undertaken as an undergraduate or as a special student even in courses designed for graduate students.

A student, who has satisfactorily completed two or more academic years of study toward the degree of M.D. at the Cornell University Medical College or another accredited medical school in the United States with a curriculum

equivalent to that of the Cornell University Medical College, may transfer a maximum of two units of residence credit after passing an evaluation examination administered by a committee appointed by the General Committee of the Graduate School of Medical Sciences.

### Study *in Absentia*

A candidate for the degree of Ph.D. may petition for permission to earn residence units for study away from Cornell University while regularly registered in the Graduate School of Medical Sciences. A candidate to whom this privilege has been granted may work temporarily under the immediate supervision of an individual designated by his Special Committee, but his program will continue to be directed by the Committee. For study *in absentia*, not more than two residence units may be earned toward fulfillment of the minimum residence requirements for the degree of Ph.D.

### Examinations

Three examinations are required by the Faculty of the Graduate School of Medical Sciences: (1) final examination for the M.S. degree; (2) examination for admission to doctoral candidacy; and (3) final examination for the Ph.D. degree. Examinations are administered by an Examining Committee consisting of a chairman appointed by the dean, the members of the candidate's Special Committee, and, in Fields that so specify, other members of the Faculty of the Graduate School of Medical Sciences and outside examiners designated by the Field. In addition to these examinations, the candidate's major Field may require a qualifying examination as part of its evaluation of the candidate after he has completed two units of residence credit.

For the M.S. degree the final examination may be oral or both oral and written.

For the Ph.D. degree the admission to candidacy examination is both oral and written and certifies that the student is eligible to present a thesis to the Faculty of the Graduate School of Medical Sciences. The examination may not be taken until two units of residence credit have been accumulated; a minimum of two units of residence credit is required after passing this examination before the final examination can be scheduled. The final examination for the Ph.D. degree is an oral defense of the candidate's thesis. It must be passed within four years after completion of the required residence units, or after seven years from the date of first registration, whichever is sooner.

### Foreign Language Requirements

Each Field of study has its own foreign language requirements. The student's Special Committee may require knowledge of foreign languages beyond the requirements of the Fields listed in this *Announcement*.

Examinations in foreign languages will be administered by the Office of the Dean at the beginning of each term. As an alternative to this examination, the candidate may demonstrate proficiency by passing the reading part

## 18 Financial Assistance

of the language qualification tests administered by the College Entrance Examination Board.

### Theses

A principal requirement for both the M.S. and the Ph.D. degrees is the presentation of a thesis constituting an imaginative contribution to knowledge. Ordinarily, the thesis is written on a research topic in the candidate's major field of study, under the direction of the chairman of his Special Committee. The Faculty requires that the Ph.D. thesis be published in abstract and be recorded on microfilm.

### Tuition and Fees

Tuition for a student regularly matriculated in the Graduate School of Medical Sciences is \$2,200 for the academic year and is payable in either two or three equal parts, the first of which is due at initial registration. Tuition includes fees for matriculation, hospitalization insurance, graduation, and miscellaneous thesis expenses.

A graduate student who has previously fulfilled all other degree requirements and who returns to the Graduate School of Medical Sciences to present his thesis and to take the final examination must register as a "Candidate for Degree Only" and pay a fee of \$35.

Part of the tuition fee will be refunded to a student who officially withdraws or takes a leave of absence during the first nine weeks of a term. A student who is to receive partial residence credit because of his employment should apply for proration of tuition on forms obtainable at the Office of the Dean.

*The amount, time, and manner of payment of tuition, fees, or other charges may be changed at any time without notice.*

### Financial Assistance

Financial assistance is usually available to qualified applicants. Individual Fields or Units may offer predoctoral research fellowships, research assistantships, or teaching assistantships. These positions may provide a stipend in addition to tuition. Information about these positions may be obtained directly from the Field or Unit at the time of application.

Nationwide, competitive predoctoral fellowships are also available from the National Science Foundation, the National Research Council, and the U. S. Public Health Service. Information about these fellowships should be requested directly from the appropriate governmental agency.

New York State residents are eligible for several predoctoral fellowships and for Scholar Incentive Awards which assist in tuition payment. Application forms may be obtained from the Regents Examination and Scholarship Center, State Education Department, Albany, N.Y. 12224.

Opportunity for part-time employment is often available in departmental research projects or other activities. Applications should be made directly to individual departments.

## **Student Health Service**

Complete ambulatory medical care is provided for all students enrolled in the Graduate School of Medical Sciences through the Personnel Health Service of the Medical Center. The student matriculating for the first time is required to have a physical examination by a member of the Health Service staff. In addition, the student must report for a chest x-ray examination, tuberculin test, and necessary immunizations. No charge is made for medical care through the Health Service nor for any x-rays, laboratory tests, or procedures which may be needed.

The student is required to carry Associated Hospital Service (Blue Cross) hospitalization insurance unless similar hospitalization insurance is currently in effect. The cost of this insurance for an unmarried student is included in the tuition fee. Wives and dependents of students may be covered by the hospitalization insurance policy for a small additional fee. Wives and families of students are not eligible for care through the Personnel Health Service but will be referred to appropriate members of the hospital staff for medical care.

# Fields of Instruction

## Instruction at the Medical College Division

### Biochemistry

Faculty: Amir Askari, Esther Breslow, Roy W. Bonsnes, George W. Dietz, Jr., M. Renate Dische, Gordon F. Fairclough, Helena Gilder, Jack Goldstein, Rudy H. Haschemeyer, S. Steven Hotta, Charles E. Inturrisi, Leonhard Korngold, Michael J. Lyons, Alton Meister, William M. O'Leary, Aaron S. Posner, Julian R. Rachele, Charlotte Ressler, Robert R. Riggio, Albert L. Rubin, W. Bruce Rowe, Brij Saxena, Edward T. Schubert, Gabriel Schwartz, Julio Sirlin, Kurt H. Stenzel, Suresh S. Tate, Daniel Wellner, Kenneth Woods.

Field Representative: Alton Meister, Department of Biochemistry, Room E-106, Medical College.

Graduate instruction is offered leading to the Ph.D. or M.S. degree. Within the framework of degree requirements and in consultation with the student, the course of study is planned to fit the needs of the individual. Although formal course work is required, emphasis is placed on research. Research opportunities exist in various areas of biochemistry including enzymology, structure and function of proteins and nucleic acids, molecular biology, physical biochemistry, and the intermediary metabolism of amino acids, carbohydrates, nucleic acids, and lipids. Entering graduate students usually work for short periods in several of the laboratories of the faculty members of the Field before beginning thesis research. Students are encouraged to choose challenging and fundamental research problems that are on the frontiers of biochemistry.

The laboratories of the faculty members are equipped with virtually all of the instruments and facilities required for modern biochemical research; thus, graduate students are instructed in such methodology as chromatography, counter-current distribution, radioactive and stable isotope techniques, spectrophotometry, electrophoresis, and analytical ultracentrifugation.

Students undertaking graduate study in biochemistry must have a sufficiently comprehensive background in chemistry to pursue the proposed course of study and must present evidence of knowledge of biology, general experimental physics, and mathematics (including differential and integral calculus). Opportunity is offered to remedy deficiencies in these areas during the first year of graduate study. The Graduate Record Examinations

(the Aptitude Test and the Advanced Test in Chemistry) are ordinarily required.

**LANGUAGE REQUIREMENTS.** For the Ph.D. degree the requirement is proficiency in two modern foreign languages which are acceptable to the student's Special Committee. For the M.S. degree, proficiency in one foreign language suffices.

Proficiency in a computer science language, as demonstrated by executing a meaningful program, may substitute for proficiency in one of the required foreign languages.

**EXAMINATIONS.** The qualifying examination is not ordinarily required; however, the major sponsor or Special Committee of any student has the prerogative of adding this requirement.

### Special Interests of the Faculty

- E. Breslow: physical chemistry of neurophysin; myoglobin; metal ion-protein interactions.
- R. Bonsnes: intermediary metabolism; static and dynamic composition of body fluids.
- G. Dietz, Jr.: nucleic acid biochemistry; biochemical mechanisms of transport.
- G. Fairclough: protein chemistry; clinical biochemistry.
- H. Gilder: metabolic response to surgery; electrolyte studies of gastric juice; studies in experimental shock.
- J. Goldstein: hemoglobin structure; role of RNA in protein synthesis; coding; fractionation of RNA.
- R. Haschemeyer: structure of fibrinogen and subunit interactions in protein and nucleoproteins; electron microscopy of enzymes and viruses.
- S. Hotta: intermediary metabolism of brain; fundamental aspects of maintenance of cellular sulfhydryl groups.
- A. Meister: enzymology; proteins and amino acids.
- A. Posner: crystal chemistry; ultrastructural biochemistry; atomic structure of bone; hard tissue chemistry.
- J. Rachele: metabolism of amino acids, one-carbon units, and methyl groups; isotope effects.
- C. Ressler: relationship of amino acid metabolism in certain plants and microorganisms to human nutrition and disease; special

aspects of the chemistry of amino acids and peptides.

- A. Rubin: collagen structure and function; biomaterials research; dialysis; transplantation research.
- W. Rowe: urea formation; action of methionine sulfoximine.
- B. Saxena: chemistry, measurement, and mechanism of action of pituitary protein hormones.
- E. T. Schubert: enzyme studies of the developing kidney; investigation of renal dysfunction at enzyme level.
- K. Stenzel: transplantation; dialysis and biomaterials research.
- S. Tate: structure-activity relationships in enzymes; vitamin B<sub>6</sub> derivatives.
- K. Woods: physicochemical understanding of human blood fractions; blood coagulation; structure of antibodies.

## Courses Offered

**1. General Biochemistry.** This introductory course is designed to provide the student with a knowledge of the fundamentals of biochemistry and an appreciation of the molecular basis of biological phenomena. Instruction includes lectures, demonstrations, assigned readings, reports, and laboratory work on proteins, nucleic acids, enzymes, carbohydrates, fats, vitamins, hormones, and other compounds of biological importance. Consideration is given to metabolism, genetics, nutrition, and to the application of biochemical and biophysical principles to biological phenomena. First trimester: M W F 1-2, and T 2-3. Second trimester: M T Th 12-1, and F 11-1.

Graduate students in biochemistry are required to pass this course (or its equivalent) prior to pursuing advanced courses.

**2. Kinetics and Enzyme Mechanisms.** This course is also open to medical students with the necessary prerequisites and is given in two parts, each part consisting of one two-hour session per week for five weeks. Part I reviews the basic principles of kinetic analysis of enzymatic reactions. Examples from the literature are chosen to illustrate how kinetic data are used to elucidate enzyme mechanisms. Part II of the course is designed primarily with the graduate student in mind and requires extensive student participation. Several examples of interesting or unusual enzymes are discussed in depth. The mechanism of the reaction is considered in terms of the structure, biological role, and regulatory properties of the enzyme. Third trimester: hours to be announced. Professor Daniel Wellner.

**3. Nucleic Acids—Selected Topics.** The topics will be concerned with template ribonucleic acids, i.e. tRNA and mRNA, and will cover their isolation, characterization, and biological properties (including their roles in protein biosynthesis). The course consists of lectures and demonstrations, given in one two-hour session per week for five weeks. Students are expected to do a fair amount of reading, give reports and participate in discussions. The topics are studied on the basis of inherent interest and as examples of general problems encountered in nucleic acid research. Third trimester: hours to be announced. Professor Goldstein.

**4. The Biochemistry of Transport.** The course explores the recent advances in the study of active transport. Special emphasis is given to bacterial transport systems. Certain problems in mammalian transport, including the Na<sup>+</sup> and K<sup>+</sup> dependent ATPase, are discussed. The course is given in one two-hour session per week for five weeks. Third trimester: hours to be announced. Professor Dietz.

**5. Advanced Graduate Biochemistry.** The course is offered jointly by the Faculties of the Medical College and Sloan-Kettering Divisions. Details are given on p. 34 under *Interdivisional Courses*.

## Biological Structure and Cell Biology

Faculty: Carl G. Becker, Dorothea Bennett, Dana C. Brooks, Peter G. Bullough, John T. Ellis, James L. German III, Michael D. Gershon, Fakhry G. Girgis, Jack Goldstein, Roger L. Greif, Wilbur D. Hagamen, Martin D. Hamburg, Myron S. Jacobs, John MacLeod, Thomas H. Meikle, Jr., C. Richard Minick, Leonard L. Ross, Charles A. Santos-Buch, Edward T. Schubert, Gabriel H. Schwartz, John F. Seybolt, Julio L. Sirlin, Kurt H. Stenzel, Dieter H. Sussdorf, Roy C. Swan, John C. Weber, Myron Winick.

Field Representative: Michael D. Gershon, Department of Anatomy, Room A-016, Medical College.

Graduate study in the Field of Biological Structure and Cell Biology leads to the Ph.D. degree and emphasizes the basic relationships between structure and function of biological systems at all levels of organization. Thus the Field is fundamentally concerned with the nature, development and functional modulation, and significance of configuration, pattern and other spatial relations in biological systems. The scope of interest extends from the molecular level to that of the whole



**Cornell University Medical College**

- 1 Anatomy Building
- 2 William H. Harkness Medical Research Building
- 3 Samuel J. Wood Library and Research Building
- 4 Biochemistry-Pharmacology Building
- 5 Olin Hall

- 6 Livingston Farrand Apartments
- Sloan-Kettering Institute for Cancer Research
- 7 Kettering Laboratory
- 8 Howard Laboratory
- 9 Margaret Caspary Research Building





**10 Institute for Muscle Disease**  
**11 The New York Hospital**  
**12 Payne Whitney Psychiatric Clinic**  
**13 Nurses Residence**  
**14 Payson House**

**15 Memorial Hospital**  
**16 Ewing Pavilion**  
**17 Sloan House**  
**18 Norman Winston House**  
**19 Rockefeller University**

## 24 Instruction—Medical College

organism and embraces normal as well as pathological structure.

Opportunities for research training include the investigation of cellular fine structure, using such techniques as light and electron microscopy, isolation and analysis of cellular sub-fractions by differential ultracentrifugation, histochemistry, cytochemistry, and enzyme neuroanatomy, including the physiological correlates of changing neural structure.

For graduate study in the Field of Biological Structure and Cell Biology, adequate undergraduate preparation in biology, chemistry, (including organic chemistry), physics, and mathematics is recommended. Requirements for admission are flexible in proportion to the promise and accomplishments of the applicant. Applicants are generally requested to present the results of the Graduate Record Examinations.

Requirements for minor sponsorship in the Field of Biological Structure and Cell Biology will be arranged with individual students, but research experience in the minor sponsor's laboratory is strongly encouraged.

In addition to the courses offered by the Field and listed below, appropriate courses for graduate students in the Field are General Biochemistry and those courses given by the Field of Neurobiology and Behavior.

**LANGUAGE REQUIREMENTS.** A reading knowledge of French, German, Spanish, or Russian is desirable; proficiency in a foreign language may be required for a candidate by his Special Committee.

### Special Interests of the Faculty

- D. Bennett: mammalian genetics, with special reference to genetic regulation during early embryonic development.
- D. C. Brooks: spontaneous electrical activity of the central nervous system; brain stem influences upon the visual system during sleep and wakefulness in the cat.
- P. G. Bullough: combined clinical, biochemical and histological study of osteogenesis imperfecta; and histological study of the pathogenesis of chondromalacia and cartilage breakdown.
- J. T. Ellis: experimental pathology.
- J. L. German: clinical and laboratory investigation in the field of human and medical genetics, particularly emphasizing cytogenetics.
- M. D. Gershon: the role of monoamines and the action of psychotomimetic drugs in the mammalian nervous system.
- F. G. Girgis: the cranial and facial sutures; their development, structure and the analysis of sutural position. Special attention is given to factors inducing chondrogenesis in the cranial vault.

W. D. Hagamen: self-stimulation, habituation, and changes in affective behavior in cats; artificial intelligence in computers.

M. S. Jacobs: anatomy of the cetacean central nervous system.

J. MacLeod: research in human male reproduction.

T. H. Meikle, Jr.: animal studies of neural mechanisms basic to learned behaviors, particularly visual learning.

T. C. Rodman: analytical cytology of cell nuclei; cytogenetics.

L. L. Ross: morphological and biochemical studies of central nervous system synapses.

R. C. Swan: fine structure of excitable cells.

J. C. Weber: vitamin D and mineral metabolism in hard tissue.

### Courses Offered

**1. Microscopic Anatomy.** The course in Microscopic Anatomy and Development offered by the Department of Anatomy in the Medical College to the first-year medical class is open to graduate students. Selected concepts of fine structure, the mechanisms by which structure develops, differentiates, and ages, and the genetic control of these mechanisms are presented in the lectures to indicate a pattern of study and depth of analysis which the student can be expected to apply to his informal study of cells and tissues. First trimester: M W F 9-10, and Th 12-1. The staff.

**2. Laboratory in Microscopic Anatomy.** The laboratory consists of a series of discussions and exercises designed to acquaint the student with the fundamental principles of microscopic anatomy. The students are issued slides to view through their own microscopes. Kodachrome transparencies are shown to supplement the slide collection. The lectures in Microscopic Anatomy and Development are corequisites or prerequisites. First trimester: T Th 2-4. Professors deHarven (SKD), Gershon, Ross, Sanders (SKD), and Sternberg (SKD).

**3. Gross Anatomy.** Regional anatomy is studied principally through dissection of the human body. Supplementing this are projections by instructors, tutorial group discussions and radiographic and endoscopic demonstrations. First trimester: T 10-1, and Th 9-12, 2-5. Second trimester: M 9-12, W 9-1. The staff.

**4. Gross Anatomy Lecture Course.** Each week the class begins with a fifteen-minute presentation of a patient and a discussion of his case, emphasizing the applications of gross, microscopic and developmental anatomy to diagnosis and therapy. The case

presentation is followed by a forty-five-minute lecture in which a few major anatomical concepts relevant to the case are developed. The case presentations and lectures are scheduled to correlate with the course in gross anatomy and with the course in radiographic anatomy. First and second trimesters: T 3-4. Professor Swan.

**5. Radiographic Anatomy.** Correlation of normal radiographic anatomy with current dissection in gross anatomy. Emphasis on potential clinical application. First and second trimesters: W. Hours to be arranged. Professor Stassa.

**6. Seminar.** Seminars are scheduled on selected topics in biological structure including fine structure, development, cell biology, neuroanatomy, and genetics. Senior members of the staff and guest speakers conduct informal discussions on current research in their respective fields. Hours to be arranged. The staff.

## Biomathematics

Faculty: Betty J. Flehinger, Richard P. Kelisky, Evelyn F. Keller, Joel L. Lebowitz, Sol I. Rubinow, Tai Te Wu.

Field Representative: Sol I. Rubinow, Division of Biomathematics, Room C-208, Medical College.

The Field of Biomathematics offers a wide range of opportunities for the development of quantitative methods in the biological and medical sciences, with special emphasis on the application of mathematics. Graduate study programs leading to advanced degrees in the Field of Biomathematics are available to students whose primary interests are mathematical, but who wish to concentrate on biological or medical applications.

Graduate students are admitted to study in this Field from a variety of educational backgrounds, including the several branches of engineering and the physical and biological sciences as well as mathematics. Their programs of study include a thorough grounding in mathematical methods and a particular biological area of interest.

The thesis in biomathematics must be a mathematical contribution toward the solution of a problem arising in a biomedical area.

Graduate students in the Field of Biomathematics are required to obtain thorough training in linear algebra, complex variables, and partial differential equations and boundary value problems. In addition to other courses, an appropriate plan of study in the relevant aspects of biology, chemistry, physics, and medicine will be made to suit the

particular area of application of the individual student. A programming language such as Fortran is required in lieu of a foreign language.

## Special Interests of the Faculty

B. J. Flehinger: biostatistics, medical diagnosis with computers, clinical trials.

R. P. Kelisky: computers in medicine.

E. F. Keller: circadian rhythms, cell chemotaxis.

J. L. Lebowitz: cell proliferation, enzyme kinetics.

S. I. Rubinow: blood flow, cell proliferation, enzyme kinetics, physiological systems.

T. T. Wu: molecular biology, bacterial genetics.

## Courses Offered

### 1. Introductory Biomathematics I, II, and III.

An introduction to the use of elementary mathematics in various areas of medicine and biology. The course is divided into three parts, offered separately in each trimester. Topics vary from year to year. Currently, Part I is concerned with data analysis and the relating of experimental observations with underlying mechanisms involved in biological processes. Part II concerns the applications of model constructions to stereology, allosteric enzymes, genetic mapping, membrane properties and centrifuge analysis. Part III is devoted to the detailed study of one of the current research topics in the Biomathematics Division. No prerequisite in mathematics is required. M F 3-4. The staff.

**2. Biomathematics Seminar.** Presentation of research investigations by the staff, as well as student reports on various topics chosen from the current literature. Required of Biomathematics majors. Hours to be arranged. The staff.

## Genetics

Faculty: Dorothea Bennett, June L. Biedler (SKD), Edward A. Boyse (SKD), Liebe F. Cavalieri (SKD), James L. German, Lloyd J. Old (SKD), Toby C. Rodman, Julio L. Sirlin, Tai Te Wu.

In addition, the following members of clinical departments in the Medical College participate in the graduate program: Professors Alexander G. Bearn, Hartwig Cleve, Betty S. Danes, Stephen D. Litwin, Selma Silagi.

Field Representative: Dorothea Bennett, Department of Anatomy, Room A-223, Medical College.

## 26 Instruction—Medical College

Academic and research training is available chiefly in the following areas: cytogenetics, human biochemical genetics, human somatic cell genetics, immunogenetics, and nucleic acid chemistry. The Faculty includes members of the preclinical and clinical departments of the Medical College and staff members of the Sloan-Kettering Division; a unique opportunity for integrating the study of genetics with other biological and medical interests is thus provided. Within broad limits each student pursues his own program according to his particular interests.

The usual prerequisites for admission to graduate study for an advanced degree in genetics are: undergraduate work in chemistry or biology, and courses in general chemistry, organic chemistry, general biology, general physics, and mathematics through calculus. Applicants may be required to present Graduate Record Examinations scores in the Aptitude Tests and in the Advanced Test in Chemistry or Biology.

Courses generally required of genetics majors are those numbered 1 through 3 below, and General Biochemistry and Microscopic Anatomy and Development given by the Fields of Biochemistry and of Biological Structure and Cell Biology, respectively. Other courses appropriate for students in genetics include those numbered 4 through 8 and Molecular Genetics and Advanced Virology offered by the Biochemistry Unit of the Sloan-Kettering Division and by the Field of Microbiology, respectively.

**LANGUAGE REQUIREMENTS.** Requirements for foreign languages are at the discretion of the student's Special Committee, although the Field recommends a reading knowledge of French, German, or Russian.

**EXAMINATIONS.** The Field recommends but does not require the qualifying examination.

### Special Interests of the Faculty

- A. G. Bearn: biochemical and somatic cell genetics of man.
- D. Bennett: mammalian developmental genetics.
- J. L. Biedler: somatic cell genetics and cytogenetics; resistance to cancer chemotherapeutic agents.
- E. A. Boyse: mammalian immunogenetics.
- L. Cavalieri: DNA replication in bacteria and bacteriophage.
- H. Cleve: human biochemical genetics, genetic variability of serum proteins, enzymes, and membrane proteins.
- B. S. Danes: somatic cell genetics, with particular emphasis on human genetic metabolic errors.
- J. L. German: mammalian cell genetics and cytogenetics.
- S. D. Litwin: genetics of immunoglobulins.
- S. J. Old: Tumor immunology.
- T. C. Rodman: cytogenetics; analytical cytology of cell nuclei.
- S. Silagi: gene action and cellular differentiation in culture.
- J. L. Sirlin: biology of RNA.
- T. T. Wu: bacterial genetics and mathematical models of nucleic acids.

### Courses Offered

**1. Genetics Seminar.** The seminar is a six-semester sequence in advanced genetics covering nucleic acid chemistry, biology of RNA, cytology and cytogenetics, developmental genetics, advanced general genetics with special emphasis on populations, and human and medical genetics. Human and medical genetics and developmental genetics will be the topics covered in 1970-71. W 2-4. Professors Bennett, and German.

**2. Human Genetics Rounds.** The course consists of a conference at which a patient with a genetic disorder is presented for discussion of both medical and genetic aspects of the condition. Given every two weeks throughout the year; M 4. Professor Cleve.

**3. Genetics Journal Club.** An informal meeting of students and staff at which current literature or research is discussed. Held every two weeks throughout the year; F 12. The staff.

**4. Basic Genetics.** This course covers the fundamentals of classical genetics and is intended for students without formal undergraduate training in genetics. First trimester: T 4-5. Professor Bennett.

**5. Medical Genetics Lectures.** This course deals specifically with genetics as it pertains to human population and human disease, covering the topics of human cytogenetics, Mendelian principles in man, and gene action pertaining to gene interaction, regulation of gene activity, inborn errors of metabolism, Hardy-Weinberg equilibrium, and mutation and selection. Second trimester: W 3-4. Professors Bennett, Bearn, Cleve, Danes, German, and Litwin.

**6. Clinical Cytology and Cytogenetics.** The course covers aspects of chromosome structure and function as well as medical cytogenetics and will entail laboratory work in karyotype preparation and analysis. The course will be limited to two students. Third trimester: 1 day a week for 7 weeks; hours to be arranged. Professor German.

**7. Biology of RNA.** The course deals with the events and controls of transcription and translation, and is essentially an intensive laboratory course where the student will learn to separate, handle, and analyze the RNA species of the mouse brain in their native biologically active configurations. The course will be limited to two students. Prerequisite is an interview with instructor. Third trimester: 14 hours per week; hours to be arranged. Professor Sirlin.

**8. Selected Mathematical Topics in Genetics.** The topics covered in this course are supplements to the regular genetics course for medical students. They include mathematical tests of genetic inheritance, contingency of genetic traits, linkage and mapping selection in a population, and biochemical genetics. Sickle cell anemia is used as an explicit example both for genetic selection and for detailed biochemical analysis of abnormal gene products. The kinetics of normal and abnormal hemoglobins are investigated in terms of their different behaviors as allosteric enzymes. Mathematics used is limited to college algebra and calculus which will be reviewed in the course. Reading assignments and homework should not require more than four hours each week. Second trimester: 2 hours per week; hours to be arranged. Professor Wu.

## Microbiology

Faculty: Robert W. Dickerman, Leonhard Korngold, Michael J. Lyons, Donald W. Mackenzie, William M. O'Leary, William F. Scherer, Laurence B. Senterfit, Gregory W. Siskind, Dieter H. Sussdorf.

Field Representative: William M. O'Leary, Department of Microbiology, Room C-209, Medical College.

Candidates for the Ph.D. degree and post-doctoral fellows can select an area of research interest and activity from such microbiological topics as general and medical bacteriology, microbial chemistry and physiology, microbial genetics, immunology, mycology, and virology.

Prospective students should complete at the undergraduate level a minimum of one year (or its equivalent) in general chemistry, organic chemistry, general physics, mathematics (including college algebra), botany or zoology (preferably both), and one semester or its equivalent of analytical or quantitative chemistry. General microbiology or bacteriology and calculus are strongly recommended. Students who have not completed the above requirements may be admitted to graduate study on the condition that deficiencies be removed soon after admission.

Individual programs, including the selection of courses, are determined by the student's Special Committee made up of faculty members representing his major and minor subjects. The following courses may be selected by Ph.D. candidates in microbiology: medical microbiology, microbial chemistry and physiology, advanced immunology, advanced virology, microbial genetics, microbiology seminar, biochemistry, and biostatistics.

The nature and number of other courses depend on the student's minor subjects, his research activities, his individual interests, and the advice of his Special Committee. Courses outside the Field of Microbiology in anatomy, biophysics, cell biology, histology, mycology, parasitology, pathology, pharmacology, physiology, and radiobiology are available at this institution or nearby universities.

**LANGUAGE REQUIREMENTS.** Two modern foreign languages are required for the Ph.D. degree.

## Special Interests of the Faculty

R. W. Dickerman: involvement of birds and mammals in the ecology of mosquito-transmitted viruses.

L. Korngold: antigenic structure of immunoglobulins and of various human tissues.

M. J. Lyons: biochemical and morphological aspects of the interaction of arboviruses with vertebrate and ecologically related arthropod cells; morphogenesis of arboviruses.

D. W. Mackenzie: strain differentiation of pathogenic fungi and application to epidemiology, pathogenesis and immunogenesis, relationship between morphogenesis and pathogenesis of *Candida albicans*.

W. M. O'Leary: microbial cellular composition, exo- and endo-toxin structure and function, mechanisms of pathogenesis, microbial lipids.

W. F. Scherer: cell-virus relationships, virus virulence, host defense mechanisms, ecology and epidemiology of arboviruses, especially mosquito-borne encephalitis viruses of tropical North and Central America.

L. B. Senterfit: antigenic structure of mycoplasma; pathogenesis of respiratory viral and mycoplasmic disease, vaccine development, clinical microbiology.

G. W. Siskind: factors involved in control of the immune response; changes in antibody affinity and heterogeneity with increasing time after immunization.

D. H. Sussdorf: function of the thymus and related lymphoid tissues in development of immunocompetence; cellular and molecular aspects of antigen degradation.

## 28 Instruction—Medical College

### Courses Offered

Students who wish to attend any of the following courses either for credit or as an auditor should contact the office of the Department of Microbiology or the faculty member responsible for each course well in advance of the beginning of each course. In general, as many students as possible are accommodated in lectures; however, participation in laboratory sections is restricted.

**1. General Microbiology.** This course is offered by the staff of the Field of Microbiology of the Medical College Division and of the Biology Unit of the Sloan-Kettering Division. For details, refer to *Interdivisional Courses*, p. 35. Given every second year. Given in 1970–71. September through June. Th 3–5. Professors Hutchison (SKD) and O'Leary.

**2. Microbiology and an Introduction to Infectious Disease.** This course is presented in the first and second trimesters and consists of laboratory experiments, lectures, and group discussions. The laboratory work includes an introduction to the procedures used in studying microorganisms, experiments on various physical and biological manifestations of antigen-antibody reactions, the actions of chemotherapeutic agents, a survey of the microbial flora of the upper respiratory and lower intestinal tracts of healthy humans, and an intensive study of the causal agents of specific infections, including fungi, spirochetes, rickettsiae, and viruses, as well as bacteria. The lectures are directed toward the development of basic concepts, particularly the principles involved in microbial growth, the principles underlying active immunization, and the factors that enter into host-parasite relationships. Emphasis is placed on aspects related to the etiology, pathogenesis, epidemiology, and prevention of infectious disease. Special attention is also given to the immunological principles underlying such noninfectious conditions as hypersensitivity, autoimmunity, and rejection of tissue transplants. Given every year. Professor William F. Scherer.

**3. Advanced Diagnostic Microbiology.** The lecture and laboratory sessions acquaint the student with the procedures used in and technique of management of a clinical microbiology laboratory. Emphasis is upon developing the student's capability in the isolation and rapid identification of organisms from various types of clinical specimens. Liberal use is made of clinical materials available through the diagnostic laboratories of the New York Hospital. Given every other year in the third trimester. Not given 1970–71. Professor Laurence B. Senterfit.

**4. Microbial Chemistry and Physiology.** Two lectures and two laboratory periods weekly.

Lectures cover literature and methodology pertinent to physicochemical properties of microorganisms and their environments, the growth and death of microorganisms, chemical composition of cells and subcellular structures, nutritional requirements, microbiological assay and auxotrophic mutants, energy metabolism, degradations and biosyntheses, the physiology of pathogenesis, and important microbial products. Laboratory sessions provide experience with large-scale culture and recovery of cells, synthetic media, microbiological assay, extraction of cellular constituents, respirometry, and studies of substrate utilization employing radioactive metabolites. Minimal prerequisites are general microbiology, qualitative and quantitative analysis, organic chemistry, and at least one semester (or its equivalent) of biochemistry. Third trimester: T Th 3–5. Professor O'Leary.

**5. Advanced Immunology.** Two lectures and two laboratory periods weekly. Lectures emphasize current concepts regarding antigen and antibody structure, the physical and biological manifestations of antigen-antibody reactions, and recent developments in studies on the cellular basis of immunity, including antibody formation. The laboratory will cover the isolation, purification, and quantification of antibodies; the critical measurement of antigen-antibody reactions; histological mechanisms during the immune process; and *in vivo* effects of specific antigen-antibody reactions. Minimal prerequisites are introductory immunology (as given in courses in general microbiology) and at least one semester (or its equivalent) of biochemistry. A semester course in histology or microscopic anatomy is desirable. Given every second or third year. Not given in 1970–71. Professor Dieter H. Sussdorf.

**6. Advanced Virology.** This course presents, in lectures and laboratory sessions, modern concepts and techniques of virology. Virus structure, chemical composition, physical and biologic properties, and relationships with host cells are considered in depth. Minimal prerequisites for credit are general microbiology and at least one semester (or its equivalent) of biochemistry. Given every second or third year. Not given in 1970–71. Professor Michael J. Lyons.

### 7. Arthropod-Borne Virology and Related Ecology and Epidemiology.

Section A. Principles of arthropod-borne virology.

Section B. Entomology in relation to arthropod-borne virology.

Section C. Ornithology in relation to arthropod-borne virology.

Section D. Mammalogy in relation to arthropod-borne virology.

Section E. Human and veterinary diseases caused by arthropod-borne viruses.

Section A is given at Cornell University Medical College usually during late June and early July, and sections B-E at field laboratory sites in Mexico and Central America during late July and August. Section A and one or two others are offered each summer. Members of the faculty are from Cornell and collaborating institutions in Mexico and Central America. Each section follows a syllabus and consists of literature review and analysis at Cornell University Medical College and other New York libraries, including the American Museum of Natural History, and seminars and practical experience at the field laboratory. Classes are limited to six students. The following Cornell University students are eligible: New York campus—graduate students majoring or minoring in microbiology, post-doctoral fellows in microbiology, medical students with special interest; Ithaca campus—graduate students majoring in entomology or fields of vertebrate zoology, veterinary students with special interest, undergraduate students beyond third year with special interest and sufficient biology background. Students from other universities or research institutions may enroll provided spaces are available. Given in most but not all years. Those interested should inquire at the departmental office well in advance of beginning dates. Professor William F. Scherer.

**8. Advanced Mycology.** Initial consideration is given to gross vegetative organization of fungi relating cellular and subcellular structure and function. In addition to physiological and morphological characteristics of microscopic fungi, mechanisms of biosynthesis and energy metabolism are described in reference to the interaction between fungi and their environment. Other topics considered include natural and induced variation of fungi, fungi as tools of genetic investigation, biochemical and traditional systematics, bioassays and steroid transformations.

Basic features of fungal growth are considered, and attention is also directed to the various associations between fungi and man. These include the role of fungi as sources of important microbial products, as causes of spoilage and destruction and as pathogenic, toxigenic and allergenic agents of human disease.

Lectures are supplemented with laboratory exercises designed to provide familiarity with specialized mycological procedures, with the handling of fungi as genetic models and in bioassay systems, and with the methods for isolation and identification of fungi from clinical materials. Two lectures weekly. Two laboratory sessions weekly for five weeks. Given in ten weeks from March to mid-May.

Every second or third year. Not given 1970-71. Professor Donald W. Mackenzie.

**9. The Methods and Materials of Research.** This is intended to be an experimental and wide-ranging course given by all the faculty of the Field. It covers such diverse and essential subjects as logic and scientific method, manuscript preparation, the nature and use of the scientific literature, scientific photography, evaluation and choice of equipment, national scientific resources, and other matters yet to be determined. The purpose of this course is to provide students with some familiarity, even if limited, with many subjects not covered by any other course and yet essential to the practicing scientist. Given every second year. Given in 1970-71 throughout the school year. The staff.

**10. Research on Special Problems.** This course is designed for students in other Fields who wish to obtain some significant experience in microbiological research. For these students and others who want such experience, this Field offers individualized research on special problems. The nature, complexity, and time required for such research vary according to the needs and desires of each student. Such experience is available in each specialty covered by the faculty of this Field and can be arranged by consultation of the student with the appropriate faculty member. Available each year and throughout the year. The staff.

**11. Thesis Research in Microbiology.** Required of all students taking a major in microbiology. Given yearly and throughout the year. The staff.

**12. Microbiology Seminar.** These seminars consist of reports on surveys of the literature in the Field and on current research and are presented by graduate students, faculty and visiting scientists. Attendance is required of all students majoring or minoring in microbiology throughout their programs of study. Given yearly and throughout the year. One-hour sessions on alternate weeks. Professor Donald W. Mackenzie.

## Neurobiology and Behavior

Faculty: Dana C. Brooks, Michael D. Gershon, Sanford Goldstone, Bernice Grafstein, Wilbur D. Hagamen, Martin Hamburg, S. Steven Hotta, Myron S. Jacobs, John E. Lee, Thomas H. Meikle, Jr., Michiko Okamoto, Robert S. Porro, Donald J. Reis, Walter F. Riker, Jr., Leonard L. Ross, William N. Schoenfeld, Gerard P. Smith, Roy C. Swan, Myron Winick.

Field Representative: Leonard L. Ross, Department of Anatomy, Room A-404, Medical College.

## 30 Instruction—Medical College

The Field of Neurobiology and Behavior provides training in the study of the nervous system. It includes the disciplines of neuroanatomy, neuroembryology, neurophysiology, neuropharmacology, neurochemistry, neuroendocrinology, and neuropsychology and perception. The program of the Field emphasizes a multidisciplinary approach to the study of the nervous system, based on the belief that future advances in our understanding of the nervous system will be derived from a knowledge of the thinking and research techniques employed by more than one discipline. Towards this end, the program of the student entering the Field is planned in consultation with several staff members, and the student is expected to spend some period of time working closely with members of the faculty whose interests are related to his. In addition there are regularly scheduled seminars in the Field during which various aspects of work in progress are presented and discussed. By this means, the student is afforded the broadest possible view of the Field during his total training experience.

The student who chooses Neurobiology and Behavior as a major field will be required to satisfy the requirements of the courses in neural sciences, statistics, and biomathematics and two of the following: microscopic anatomy, physiology, biochemistry, or pharmacology. In addition, participation in the seminar program is expected. While there are no language requirements, it is suggested that the student achieve mastery of a modern foreign language or a computer language. When Neurobiology and Behavior is chosen as a minor field of study, the student is required to participate in the neural science course and the seminar program as well as any additional experience which the minor adviser may suggest.

### Specials Interests of the Faculty

- D. Brooks: brain stem influence upon the electrical activity of the visual system during both sleep and waking.
- M. Gershon: development of the autonomic innervation of the gut.
- B. Grafstein: growth of nerve and the transport of materials in axons.
- M. Hamburg: neural code of hunger motivation utilizing the techniques of single unit recording.
- M. Jacobs: comparative cytomorphological organization of the cetacean nervous system.
- T. H. Meikle: animal studies of neural mechanisms basic to learned behavior, particularly visual learning.
- R. Porro: histological, histochemical and

electron microscopic studies of human neurological disorders.

- D. J. Reis: central neural regulation of cardiovascular function and biogenic amines and aggressive behavior.
- W. Riker: pharmacology and physiology of neuromuscular transmission.
- L. L. Ross: biochemical morphology of central nervous system synapses.
- W. Schoenfeld: effects of long-term stress upon selected behavioral and physiological systems and reinforcement schedules in behavior theory.
- G. Smith: feeding behavior, emotional behavior and learning in rats and monkeys, utilizing the concepts of neuroendocrinology.
- R. C. Swan: fine structure of the cerebellar cortex.
- M. Winick: cellular development of the nervous system.

### Courses Offered

**1. Neural Sciences.** This is the basic undergraduate medical course and is required of all major and minor candidates in the Field. It is a broadly based course taught by members of the Field and introduces the student to neuroanatomy, neurophysiology, and pertinent neurology. Second trimester: T Th 10-12, and F 2-5. Professors Brooks and Grafstein.

**2. Development of Form and Function in the Nervous System.** Through lectures, student presentations, and discussions, selected areas of interest in the developing nervous system are treated. The topics studied include examples of biochemical, morphological and electrical development with special emphasis on central mechanisms. Hours to be arranged. Professors Grafstein, Gershon, Jacobs, Ross, and Winick.

**3. Electrical Activity of the Central Nervous System.** This course considers a range of experimental evidence relating electrical activity of the central nervous system to brain function and behavior. Several methods of electroencephalography and single cell recording are discussed and demonstrated. Hours to be arranged. Professor Hamburg and staff.

**4. Seminar.** The main objective of the Field seminar program is to foster the exchange of ideas between those members of the Faculty and students who are concerned with the nervous system. By means of a varied format, including both formal presentations and informal group discussions, research topics of past, current, or future interest are explored. The active participation of major and minor candidates in the Field is required. Hours to be arranged. The staff.



## Pathology

Faculty: Daniel R. Alonso, Carl G. Becker, Peter G. Bullough, Margaret H. S. Clements, M. Renate Dische, John T. Ellis, George F. Gray, Milton Helpern, Aaron Kellner, John G. Kidd, Robert C. Mellors, C. Richard Minick, Janet Mouradian, George E. Murphy, Alfred M. Prince, Robert S. Porro, Charles A. Santos-Buch, John E. Seybolt, Myron Susin, Carolyn W. Watson, Jack Woodruff.

Field Representative: Carl G. Becker, Department of Pathology, Room C-444, Medical College.

Pathology is the study of the causes and mechanisms of disease processes. The purpose of a graduate program in pathology is to provide individuals with a baccalaureate or medical degree with a basic knowledge of disease processes by a study of the disciplines of anatomic and clinical pathology and by learning modern techniques of biological investigation. It is hoped that a student completing this program will have both the information and technical skills to make significant inquiries into the nature of disease processes and to bridge the gap between classical, descriptive pathology and such disciplines as biochemistry and molecular biology.

The graduate program in pathology includes the observation of diseases in their various forms at autopsy and in clinical laboratories and study and research in the areas of immunology and immunopathology, oncology, virology, cellular biology and electron microscopy. It may also include study in advanced mathematics, physiology, biophysics, pharmacology, anatomy, cytochemistry and histochemistry, advanced biochemistry, genetics and microbiology.

New students are expected to have completed mathematics through integral calculus, chemistry through organic chemistry (although physical chemistry is recommended), basic physics, and at least general biology. A reading knowledge of at least one foreign language is suggested but not required. For those students entering the program with baccalaureate degrees only, the Graduate Record Examination, including the Aptitude Tests and the Advanced Test in Biology or Chemistry, is required.

Graduate students in pathology are required, as an initial part of their program, to take the course in general and systemic pathology offered to second-year medical students. They are required to minor in at least one and not more than two other biomedical fields. Courses in biomathematics, advanced biochemistry, genetics, and microbiology are also required. Additional courses

not available at the Graduate School of Medical Sciences can be taken at neighboring institutions with approval of the Department of Pathology and the candidate's Special Committee.

## Special Interests of the Faculty

- D. R. Alonso: cardiovascular pathology.
- C. G. Becker: cardiovascular and renal diseases; immunopathology; host-parasite relationships.
- P. G. Bullough: diseases and metabolism of bone.
- M. H. S. Clements: exfoliative cytopathology.
- M. R. Dische: pediatric pathology; biochemistry of metabolic diseases; biochemistry.
- J. T. Ellis: electron microscopy; kidney disease and muscle diseases.
- G. F. Gray: surgical pathology.
- M. Helpern: forensic pathology.
- A. Kellner: immunohematology; lipid metabolism; pathogenesis of arteriosclerosis.
- J. G. Kidd: virology and oncology.
- R. C. Mellors: studies in immunopathology relating to the role of viruses in autoimmune disease and leukemogenesis.
- C. R. Minick: pathogenesis of arteriosclerosis and hypertension; lipid metabolism; immunopathology; electron microscopy.
- J. Mouradian: surgical pathology.
- G. E. Murphy: cardiovascular diseases; host-parasite relationships.
- R. S. Porro: neuropathology; ultrastructure and histochemistry of diseases of central nervous system and skeletal muscle.
- A. M. Prince: virology; pathogenesis of liver diseases.
- C. A. Santos-Buch: cellular biology; immunopathology; cardiovascular disease; electron microscopy.
- J. E. Seybolt: exfoliative cytopathology.
- M. Susin: pathology of renal disease; electron microscopy.
- C. W. Watson: exfoliative cytopathology.
- J. Woodruff: virology.

## Courses Offered

**1. General and Systemic Pathology.** Lectures, practical classes and seminars. First trimester: M W F 9-1. Second trimester: M W 10-1, Th 9-1. The staff.

**2. Correlative Pathology.** Gross and microscopic material is correlated and related to the disease processes. The staff.

**3. Forensic Pathology.** Courses are offered in the above by special arrangement with the

## 32 Instruction—Medical College

chief medical examiner of the City of New York. Professor Milton Helpen.

**4. Seminars in Pathology.** Discussions outlining the scope of modern pathology are given weekly. These include reports on original research by members of the staff and by visiting lecturers. Hours to be announced. The staff.

**5. Experimental Pathology.** Independent research projects in various areas of pathology are offered. The staff.

The following courses are given by various members of the Field in collaboration with faculty members of related Fields. The terms and hours are by arrangement.

- a. Immunopathology.
- b. Cardiovascular pathology.
- c. Autopsy pathology.
- d. Orthopedic pathology.
- e. Renal pathology.
- f. Gastrointestinal pathology.
- g. Neuropathology.
- h. Surgical pathology.
- i. Cytopathology.
- j. Tumor pathology.
- k. Clinical Biochemistry.
- l. Hematology and Immunohematology.
- m. Clinical Microbiology.

### Pharmacology

Faculty: Amir Askari, John J. Burns, Walter W.-Y. Chan, Arthur H. Hayes, Jr., Raymond W. Houde, Charles E. Inturrisi, Roberto Levi, Walter Modell, Michiko Okamoto, Walter F. Riker, Jr., Alan Van Poznak.

Field Representative: Amir Askari, Department of Pharmacology, Room E-303, Medical College.

In graduate training, emphasis is placed on sound basic training in general pharmacology. By means of individual instruction, the candidate is later afforded an exposure to several specialized aspects of pharmacology. The latter part of the graduate curriculum is devoted to research in an area of the candidate's choice.

An adequate preliminary training in organic chemistry, physical chemistry, biochemistry, and physiology is prerequisite to graduate work in pharmacology. Training in statistics is strongly recommended.

Proficiency in one foreign language is required of all Ph.D. candidates majoring in pharmacology.

### Special Interests of the Faculty

- A. Askari: biochemical pharmacology; mechanisms of drug effects on the transport of ions through biological membranes.
- J. J. Burns: biochemical pharmacology; drug metabolism.
- W. W.-Y. Chan: renal pharmacology; pharmacology of neurohypophyseal hormones and related polypeptides.
- A. H. Hayes, Jr.: clinical pharmacology; cardiovascular pharmacology.
- R. W. Houde: clinical pharmacology of the analgesic drugs; development of methods of evaluating the effects of drugs on subjective responses.
- C. E. Inturrisi: biochemical pharmacology; drug metabolism.
- R. Levi: cardiovascular pharmacology; heart electrophysiology.
- W. Modell: clinical pharmacology; pharmacology of cardiac drugs; adverse drug reactions.
- M. Okamoto: neuropharmacology, especially neuromuscular transmission.
- W. F. Riker, Jr.: general pharmacology, neuropharmacology, especially neuromuscular transmission.
- A. Van Poznak: pharmacology of halogenated hydrocarbons; neuropharmacology.

### Courses Offered

**1. General Pharmacology.** The basic pharmacology course offered to second-year medical students is open to graduate students. The course consists of lectures, laboratory work, demonstrations, and seminars given during the first and second trimesters. The purpose of these exercises is to teach the principles of pharmacology. Detailed consideration is given to the parameters of drug action to provide the student with the fundamental concepts essential for the evaluation of any drug. Consequently, emphasis is placed on the scientific basis of pharmacology. Prototype drugs, considered essentially systemically, serve to illustrate several mechanisms and parameters of drug action. Therapeutic applications are considered only insofar as they illustrate principles of pharmacology or drug hazards. Prerequisites: biochemistry and physiology. First trimester: T 11-12, Th 2-3, F 9-11. Second trimester: M W 9-10, T Th 9-12. The staff.

**2. Research in Pharmacology.** Research opportunities may be arranged throughout the year for graduate students who are not majoring in pharmacology but who wish some investigative experience in the discipline. Special opportunities are offered for

work on the nervous and cardiovascular systems and in biochemical aspects of pharmacology. The staff.

**3. Advanced Courses and Seminars.** The Field of Pharmacology offers several advanced courses and seminars in the areas that are of interest to the faculty of the Field and the graduate students. The content, the format, and the schedule of these courses are determined each year on the basis of the number and the backgrounds of the interested students. The staff.

## Physiology

Faculty: S. Balagura-Baruch, W. A. Briscoe, W.-Y. Chan, C. Fell, B. Grafstein, R. L. Greif, A. H. Hayes, Jr., H. G. Hempling, N. B. Javitt, R. Levi, M. Lipkin, T. M. Maack, L. A. Pilkington, R. F. Pitts, E. E. Windhager.

Field Representative: Colin Fell, Department of Physiology and Biophysics, Room C-512, Medical College.

Opportunities are offered toward the Ph.D. degree in several areas of physiology and biophysics. Ample space is available and laboratories are well equipped to provide predoctoral training in a medical environment.

**REQUIREMENTS FOR ADMISSION.** Introductory courses in biology, inorganic and organic chemistry, physics, and mathematics through the level of differential and integral calculus are required. Additional course work in these disciplines at the undergraduate level is encouraged. Although not required, candidates are urged to take the Graduate Record Examination, since performance in this examination is an important factor in the selection of applicants. Applicants with otherwise exemplary records, who lack certain course requirements, will be considered for acceptance provided that candidates remedy such deficiencies while in training.

**REQUIREMENTS FOR THE Ph.D. DEGREE.** The course of study emphasizes the importance of teaching and research in the preparation and development of individuals for careers in physiology. This goal is achieved by a combination of didactic courses, seminars, and closely supervised research leading toward the preparation of a satisfactory thesis.

A special program of study will be developed for each student in consultation with his Special Committee. In addition to the general requirements set by the Graduate School for all Fields, all candidates for the doctoral degree in physiology will be expected to meet the following specific requirements:

1. Evidence of a satisfactory background in neural sciences. Ordinarily, the course in neural science described in *Neurobiology and Behavior*, or an equivalent course, will be a prerequisite for the course in physiology and biophysics.
2. Satisfactory completion of the course in physiology and biophysics, or an equivalent course.
3. For majors and minors in the Field, a minimum of two elective courses in the Field ordinarily will be required, in addition to the course in physiology and biophysics.
4. Proficiency in reading scientific literature in one modern foreign language.
5. Satisfactory completion of an individualized laboratory experience in an area of research different from that chosen for the doctoral dissertation.

## Special Interests of the Faculty

- S. Balagura-Baruch: renal metabolism and transport of Krebs cycle intermediates.
- W. A. Briscoe: blood gas transfer in health and disease.
- W. W.-Y. Chan: pharmacology of neurohypophyseal hormones and related polypeptides.
- C. Fell: cardiovascular function: in particular, blood flow distribution, blood volume and blood volume distribution.
- B. Grafstein: nerve regeneration and transport of materials in nerve axons.
- R. L. Greif: physiology of the thyroid gland and its secretions.
- A. H. Hayes: cardiovascular and clinical pharmacology.
- H. G. Hempling: functional properties of cell membranes.
- R. Levi: heart electrophysiology; heart hypersensitivity reactions; histamine in cardiac function.
- M. Lipkin: proliferation and differentiation of normal and diseased gastrointestinal cells.
- T. M. Maack: protein transport and metabolism by the kidney.
- L. A. Pilkington: integrated renal metabolism.
- R. F. Pitts: renal metabolism of amino acids; renal regulation of acid-base balance.
- E. Windhager: renal electrolyte metabolism.

## Courses Offered

**1. Physiology and Biophysics.** Lectures and conferences in body fluids, bioelectric phenomena, circulation, respiration, and gastrointestinal function. Second trimester: 4 hours per week. The staff.

Lectures and conferences on kidney function, acid-base regulation, endocrinology, and metabolism, and a weekly laboratory on

## 34 Interdivisional Courses

selected aspects of physiology. Third trimester: 11 hours per week. The staff.

**2. Respiratory and Renal Mechanisms of Regulation of Acid-Base Balance.** Each session consists of an informal lecture and a succeeding seminar discussion based on assigned reading in the area of the immediately preceding lecture. Third trimester: 3 hours per week. 5-15 students. Professor Pitts and staff.

**3. Selected Topics in Endocrinology.** Important scientific papers dealing with certain aspects of endocrinology are distributed to the participants one week in advance of discussion. Each paper is considered in detail in a seminar directed by an investigator in the area under discussion. One or two preliminary orientation sessions are given by Professor Greif before distribution of the first scientific paper, and, if feasible, one or two laboratory days are planned. Third trimester: 3 hours per week. 6-12 students. Professor Greif and staff.

**4. Selected Topics in Gastrointestinal and Hepatic Physiology and Pathophysiology.** Topics include bilirubin metabolism and excretion, cholesterol metabolism, bile salt excretion, bile formation, esophageal motility, gastric function, intestinal cell turnover, absorption of fat, absorption of carbohydrate, the malabsorption syndrome. Third trimester: 2 hours per week. 5-12 students. Professor Javitt.

**5. Selected Topics in Respiratory Physiology.** Topics covered include: (1) physiological anatomy of the lung; (2) logical formulation and solution of clinical problems; (3) ventilation, alveolar air diagram, nitrogen washout; (4) relevant lung function tests; (5) lung volumes, effect of posture and disease; (6) diffusion, Fick equation, Bohr integration; (7) acid-base considerations in blood; (8) mechanical properties of lung; (9) ventilation-perfusion ratio and Bohr integral isopleths; (10) ecology, sealed spaces, altitude, diving; (11) lung function in the first week of life. Third trimester: 2 hours per week. Maximum of 12 students. Professor Briscoe.

**6. Selected Topics in Kidney and Electrolyte Physiology and Pathophysiology.** Lectures, seminars, and demonstrations. Topics include: (1) GFR, clearance concept, reabsorption and secretion of electrolytes; (2) concentrating mechanism; (3) electrophysiology of the nephron; (4) pathophysiology of potassium; (5) renal blood flow and its intrarenal distribution; (6) renal physiology in the newborn; (7) control of body fluid volume and tonicity; (8) pathology of renal failure; urinary sediment; pathophysiology of renal failure; (9) radiology of the kidneys; (10)

dialysis; (11) transplantation. Third trimester: 2 hours per week. Maximum of 12 students. Professor Windhager and staff.

**7. Special Topics in Cardiovascular Physiology.** Original research papers will be made available in advance of each session, and these and the general problems associated with each topic will serve as the basis for the discussion. Insofar as possible, experimental approaches to each problem will be demonstrated. To some extent, choice of topics can be determined by the interests of the group. Probable topics include: (1) regulation of peripheral blood flow; (2) cardiac work and cardiac efficiency; (3) renal blood flow; (4) pulsatile flow in arteries; (5) pulmonary vascular function; (6) blood volume and its distribution; (7) filtration and absorption of fluid in capillaries; (8) central nervous regulation of cardiovascular function; (9) cardiovascular measurements in man. Third trimester: 3 hours per week. 6-12 students. Professor Fell.

**8. Topics in Membrane Physiology.** The course is designed to introduce the student to an understanding of membrane function through an analysis of fluxes, permeability, and active transport with representative examples from erythrocytes, leucocytes, tumor cells, and excitable tissue such as nerve and muscle. Students will do laboratory experiments, read papers, and participate in discussion groups. Third trimester: 3 hours per week. 5-20 students. Professor Hempling.

**9. Development of Form and Function in the Nervous System.** The sessions will include lectures by staff members and seminar presentations by participating students, followed by discussion periods. The following topics will be covered: (1) morphology of the embryonic nervous system; (2) control of cell division; (3) development of lipid synthesis; (4) biochemical development of brainstem and spinal cord; (5) cell migration and myelination in cerebral cortex; (6) mechanisms of nerve outgrowth; (7) development of autonomic nervous system; (8) development of neuromuscular junction; (9) development of electrical activity. Third trimester: 2 hours per week. 4-20 students. Professor Grafstein and staff.

## Interdivisional Courses

**Advanced Graduate Biochemistry.** A graduate course in biochemistry is offered jointly by the faculties of the Medical College and Sloan-Kettering Divisions. In each trimester, two lectures are given each week. It is not essential that students take the course in any particular sequence. The course includes consideration at an advanced level of the

following subjects, with particular attention to contributions of recent research: *Fall 1970*—Physical Methods in Biochemistry; *Winter 1970*—Chemistry of Nucleic Acids and Proteins; *Spring 1971*—Current Concepts in Metabolic and Membrane Biochemistry. T Th 9-10:30. Professor Sonenberg and staff.

**General Microbiology.** This course is offered by the staff of the Field of Microbiology of the Medical College Division and of the Biology Unit of the Sloan-Kettering Division. It is intended to provide a general knowledge of the subject for students minoring in microbiology and for nonminors who want a background in the subject. It is not primarily intended for students majoring in the subject who already have an extensive background from undergraduate school. Lectures are given weekly during both semesters. Aspects of microbiology covered include fundamental procedures, microbial growth and physiology, genetics, immunology and serology, virology, plant and animal pathogens, and applied microbiology. Auditors from all Fields and Divisions are welcome. Th 3-5. Professors Hutchison and O'Leary.

## Instruction at the Sloan-Kettering Division

**Graduate Seminar.** The weekly graduate seminar is offered each year and is attended by all first- and second-year students of the Division. Two or three topics are selected for discussion each year. Topics are usually chosen from the following: nucleic acid and protein chemistry and biochemistry; chromosome structure and function; special topics in bacterial genetics; regulation; radiobiology; mammalian and bacterial viruses. The discussion is carried principally by graduate students under the guidance of faculty members whose area of specialization coincides with the topic. From time to time outstanding authorities are invited as guest speakers. In addition, students in the third and later years of graduate study address the seminar on the progress being made in their thesis work.

## Biochemistry

Faculty: N. W. Alcock, M. E. Balis, A. Bendich, O. Bodansky, E. Borenfreund, G. B. Brown, L. F. Cavalieri, J. D. Fissekis, M. Fleisher, J. J. Fox, A. Giner-Sorolla, S. Green, M. G. Hamilton, J. D. Karam, L. Kopelovich, W. Kreis, J. Lenard, F. P. Mamaril, J. S. Nisselbaum, J. C. Parham, M. L. Petermann, B. H. Rosenberg, J. S. Salser, I. Scheinfeld, M. K. Schwartz, V. P. Skipski, M. Sonenberg, C. C. Stock, L. Sweetman, N. J. Swislocki, T. E. Wagner.

Unit Chairman: M. Earl Balis, Sloan-Kettering Division, Room 921K, Kettering Laboratory.

Opportunities are available for advanced work and research in chemistry and metabolism, bio-organic chemistry, enzymology, hormone chemistry and action, and molecular biology.

Undergraduate requirements for a major in biochemistry include courses in inorganic chemistry, qualitative and quantitative chemistry, organic chemistry, physical chemistry, physics, general biology, and mathematics (through calculus). Any of these requirements not completed at the undergraduate level must be completed during graduate study. Applicants are urged strongly to support their applications with Graduation Record Examination scores in both the Aptitude Test (verbal and quantitative) and the Advanced Test in Chemistry or Biology.

Students electing biochemistry as a major or minor subject must complete the Medical College course in biochemistry, or its equivalent, as a minimal requirement.

In addition, students who major in biochemistry are responsible for the course matter of Advanced Graduate Biochemistry.

A reading knowledge in one foreign language (French, German, or Russian) is required.

## Special Interests of the Faculty

Biochemical analysis: N. W. Alcock, O. Bodansky, M. Fleisher, M. K. Schwartz, V. Skipski.

Biochemical genetics: A. Bendich, E. Borenfreund, L. F. Cavalieri, J. Karam, B. H. Rosenberg.

Biochemical pharmacology: M. E. Balis, A. Giner-Sorolla, S. Green, W. Kreis, J. S. Salser, C. C. Stock.

Biochemistry of cancer and carcinogenesis: M. E. Balis, A. Bendich, O. Bodansky, E. Borenfreund, G. B. Brown, M. Fleisher, S. Green, L. Kopelovich, J. C. Parham, M. K. Schwartz, C. C. Stock.

Biosynthesis of macromolecules: L. F. Cavalieri, M. G. Hamilton, J. Karam, J. Lenard, M. L. Petermann, B. H. Rosenberg, M. Sonenberg.

Chemistry and biochemistry of hormones: J. Lenard, M. Sonenberg, N. I. Swislocki.

Chemistry and biochemistry of lipids and membranes: A. Bendich, J. Lenard, V. Skipski, M. Sonenberg, N. I. Swislocki.

Chemistry of natural products: G. B. Brown, J. D. Fissekis, J. J. Fox, A. Giner-Sorolla, J. C. Parham, I. Scheinfeld.

Intermediary metabolism: N. W. Alcock, M. E. Balis, G. B. Brown, L. Kopelovich, L. Sweetman, N. I. Swislocki.

## 36 Instruction—Sloan-Kettering Division

Mechanism of enzyme activity: O. Bodansky, G. B. Brown, S. Green, J. S. Nisselbaum, M. K. Schwartz, L. Sweetman.

Structure and function of macromolecules: M. E. Balis, A. Bendich, E. Borenfreund, L. F. Cavalieri, M. G. Hamilton, J. Lenard, M. L. Petermann, B. H. Rosenberg, J. S. Salser, M. Sonenberg.

### Courses Offered

**1. Advanced Graduate Biochemistry.** The course and the hours are described on p. 34 under *Interdivisional Courses*.

**2. Molecular Genetics.** The course is concerned with the structure and function of the genetic material of bacteria and viruses. Lectures, seminars, and term reports will include the following subjects: replication, recombination, mutagenesis, transcription, translation, and regulation of gene activity. Third trimester: T Th 10:30–12. Professors Cavalieri and Karam.

### Biology

Faculty: A. M. Albrecht, J. L. Biedler, E. A. Boyse, E. deHarven, E. G. Diacumakos, E. S. Essner, J. E. Fogh, F. W. Foote, Jr., E. Fleissner, P. J. Gomas, F. L. Horsfall, Jr., D. J. Hutchinson, L. G. Koss, R. M. Krug, H. F. Oettgen, L. J. Old, F. S. Philips, F. K. Sanders, F. M. Sirotnak, S. S. Sternberg, E. H. Stonehill, M. N. Teller, L. Wade, M. S. Zedeck.

Unit Chairman: Dorris J. Hutchinson, Walker Laboratory, Sloan-Kettering Institute for Cancer Research, Rye, New York.

The program in biology is oriented toward an understanding of factors which initiate control, and modify growth and biological development. Opportunity is offered for advanced work and research in cell biology, cytology, genetics, immunology, microbiology, pharmacology and virology.

Undergraduate prerequisites for a major in biology include courses in inorganic chemistry, organic chemistry, qualitative and quantitative chemistry, physical chemistry, physics (mechanics, electricity, and magnetism; sound, heat, and light), mathematics (through calculus), and general biology or zoology or botany or microbiology. Any of these requirements not completed at the undergraduate level must be completed during the first year of graduate study. Applicants are urged strongly to support their applications with scores attained on the Graduate Record Examination in both the Aptitude Test (verbal and quantitative) and the Advanced Test in Biology or Chemistry.

Programs are determined individually on the basis of interest, training, and prior experience. Elective courses in basic medical sciences include those described for the Medical College. Formal graduate courses, seminars, and tutorials are arranged with the faculties of the Sloan-Kettering Division and the Medical College Division.

Degree requirements include a major subject and two minor subjects. The foreign language requirement will be decided by the student's Special Committee.

### Special Interests of the Faculty

Cell biology, cell differentiation, and viral and chemical carcinogenesis: J. E. Fogh, F. K. Sanders, E. H. Stonehill, M. N. Teller.

Cytology, fine structure of cancer cells: E. de Harven, E. S. Essner, S. S. Sternberg.

Genetics, drug resistance: J. L. Biedler, F. M. Sirotnak.

Immunology, tumor immunology, and immunogenetics: E. A. Boyse, H. F. Oettgen, L. J. Old.

Microbiology, drug resistance: A. M. Albrecht, D. J. Hutchison.

Pharmacology, mechanism of drug action: F. S. Philips, M. S. Zedeck.

Virology, genetics and physical and chemical structure of virus: E. Fleissner, P. J. Gomas, R. M. Krug.

### Courses Offered

**1. Cytology.** A formal course in general animal cytology. The topics include cell theory, principles of light and electron microscopy, mitosis, cytogenetics, cellular fine structure, biochemical analysis and enzymology of organelles isolated by differential centrifugation, cytopathology, and cytology of cancer cells and tissue cultures. Not given in 1970–1971.

**2. Virology.** A formal course in which major emphasis is placed on the basic mechanisms in the biology of animal viruses. The topics considered include virus structure and composition; assay of viruses and viral-specific products; interaction of viruses with receptors and antibodies; syntheses of viral nucleic acids and proteins and assembly of viral particles; structural and functional alterations in viral-infected cells; pathogenesis of viral diseases; and viral genetics. Not given in 1970–1971.

**3. Tumor Biology.** This course consists of a series of lectures on basic aspects of the cancer cell including cell differentiation, viral and chemical carcinogenesis, tumor antigens, genetics, microscopic anatomy, and the physical and biochemical behavior of cancer cells. Not given in 1970–1971.

**4. Tumorigenesis.** A series of lectures dealing with carcinogenesis and related subjects. Topics include the nature of neoplastic changes *in vivo* and *in vitro*; comparison of chemicals, viruses, and physical agents; metabolism and mechanism of action of chemical carcinogens; and genetic, hormonal, and immunological factors involved in carcinogenesis.

**5. Genetics Seminar.** The course is described on p. 26 under *Field of Genetics*.

**6. General Microbiology.** This course is described on p. 35 under *Interdivisional Courses*.

## Biophysics

Faculty: B. Djordjevic, E. R. Epp, J. Fried, A. S. Gelbard, E. W. Hahn, N. D. Kessarls, J. S. Laughlin, S. M. Lehnert, W. G. Monahan, H. Moroson, I. Pullman, R. S. Tilbury, L. Zietz.

Unit Chairman: Edward R. Epp, Sloan-Kettering Division, Room 203K, Kettering Laboratory.

Graduate work is offered leading to the Ph.D. degree in biophysics and the M.S. in radiation physics. A candidate for the Ph.D. must have a B.A. or B.S. degree with a major in physics, or with a major in biology, chemistry, or mathematics and a minor in physics. A candidate for the M.S. must have a B.A. or B.S. in physics from a recognized university.

Undergraduate prerequisites for the Ph.D. candidate include courses in general physics, electricity and magnetism, mechanics, mathematics (through calculus), and thermodynamics, and acceptable laboratory experience in these subjects. Any of these requirements not completed at the undergraduate level must be completed during graduate study. Graduate course work required for the Ph.D. is flexible depending upon the student's background and basic interests but ordinarily would include advanced quantum mechanics, electrodynamics and nuclear physics and courses in the student's minor subjects. In addition, a month spent full time on a laboratory project is required in each of his two minor disciplines. The student must pass both a qualifying examination covering various basic aspects of his major and minor subjects and the examination for admission to Ph.D. candidacy. The thesis required for the Ph.D. in biophysics should demonstrate the ability of the student to make a thorough and original investigation in an important area of biophysics. There is no mandatory foreign language requirement.

Some of the research projects in bio-

physics which are pertinent to the Ph.D. program include: studies of the metabolism of various isotope-labeled compounds in man; metabolism of biologically important compounds in tissue cultures of human tumor cells, in bacteria, and in viruses; the mechanism of radiation action on bacteria, phage, yeast, and small animals, including metabolism studies with human and other tumors influenced by radiation under different environmental conditions; fundamental radio-biological studies of mammalian cells in tissue culture, using synchronized cell populations and metabolic inhibitors; trace element analysis of tissue sections by means of fluorescent x-ray spectrometers; electron spin resonance spectroscopy of free radicals in carcinogenic and irradiated compounds; study of the early radiation-induced processes in cells using high-intensity pulsed irradiation techniques; the investigation, using existing computer facilities, of mathematical models which simulate the behavior of biological systems, e.g., the proliferation of cells in human leukemia; the measurement of radiation by calorimetric, chemical, and solid-state techniques.

A candidate for the M.S. must have a B.A. or B.S. in physics from a recognized university. The candidate is expected to have completed undergraduate courses in general physics, mechanics, electronics, electricity and magnetism, modern physics and mathematics through differential equations. With regard to course work, the candidate is expected to pass satisfactorily courses selected from some of the following subjects: physics, biophysics, biology, radiobiology, biochemistry, and biomathematics. The student must minor in one of the above subjects other than physics. The thesis subject must be in the field of radiation physics and must represent a comprehensive study demonstrating a thorough knowledge of the chosen subject. A final oral examination will be given primarily on the subject of the thesis and may be preceded by a written examination covering the fundamental principles of the course work. There is no mandatory foreign language requirement.

The course of study leading to the M.S. degree in radiation physics trains physicists in the various aspects of production, measurement, and application of radiation to various medical and biological problems. These problems particularly involve the use of radiation in the diagnosis and treatment of cancer. A variety of radiation sources is available, capable of generating photons and electrons with energies ranging from 5 Kev to 25 Mev and with electron dose-rates up to  $10^{14}$  rads per second. Experience is also provided in the handling and use of many different radioisotopes. The magnitude and variety of facilities and unique radiation

## 38 Special Programs

projects at the Sloan-Kettering Institute and the Memorial Hospital are particularly pertinent for training in this area. An important feature is the coexistence of fundamental research and practical and clinical applications in the same center.

### Courses Offered

**1. Radiological Physics.** Lectures and problems. A series of hourly lectures and assigned problems in applied mathematics, fundamentals of radiation physics, x-ray and radium treatment planning, diagnostic x-ray principles, radiation protection, and uses of radioactive isotopes.

**2. Radiobiology.** A full-year course in fundamental radiobiology dealing with the effects of radiation on cells, viruses, and macromolecules, as well as on whole animals. The course also covers areas of radiation physics and radiation chemistry pertinent to radiobiology.

**3. Advanced Biophysics.** Laboratory courses in each of the topics of radiation biophysics.

**4. Biophysics Colloquia.** Reports on research in progress by faculty and outside lecturers. Required for majors in biophysics.

## Special Programs

### Joint Ph.D. Program in Epidemiology and Health Systems Engineering

Faculty: Thomas A. Hodgson, Jr., Kenneth G. Johnson, Walter Lynn, Jeanne Magagna, John P. Maher, Walsh McDermott, Katsuhiko Yano.

The Department of Public Health, Cornell University Medical College, in joint sponsorship with the Center for Environmental Quality Management (CEQM), Cornell University, offers graduate training and research leading to the Ph.D. degree in epidemiology and systems engineering. The required course work is given at the Ithaca campus; research projects are based primarily in the Department

of Public Health at the Medical College. Opportunities for research cover a large area. The development of disease models, the application of systems analysis to health planning, and the epidemiology of specific diseases constitute the current areas of research which are jointly supported by the CEQM-CUMC group.

Applicants must fulfill the admission requirements of the Graduate School of Cornell University. Final selection is made by a joint CEQM-CUMC committee.

The University does not grant M.P.H. or D.P.H. degrees.

### Coordinated M.D.—Ph.D. Programs in the Cornell University Medical College and Graduate School of Medical Sciences

Programs of study leading to the Ph.D. degree are available to (1) entering medical students, (2) medical students already matriculated at Cornell University Medical College, and (3) resident physicians.

(1) **Entering Medical Students.** The applicant to this program must apply to both the Cornell University Medical College and the Graduate School of Medical Sciences and be accepted under the admissions procedures of both schools.

The purpose of this program is to expose the student to both medical and graduate disciplines from the outset. The student spends his first two years as a medical student studying the basic medical sciences and attending regular graduate seminars. The summer months are spent in the laboratory learning experimental techniques and doing research. The third and fourth years of the

student's program are spent as a full-time graduate student and are devoted exclusively to laboratory research and writing the thesis. The fifth year of the program is spent as a medical student in clinical study. The sixth year can be spent in either laboratory or clinical work. This six-year program represents the minimum time required to satisfy residence requirements of both the M.D. and Ph.D. degrees at Cornell University.

(2) **Matriculated Medical Students.** A medical student enrolled in the Cornell University Medical College may interrupt his medical studies at any time to pursue full-time graduate study leading to the Ph.D. degree. The student must fulfill all regular requirements of the Graduate School of Medical Sciences. A maximum of two residence credits for basic science course work taken in the medical curriculum can be granted toward



the Ph.D. degree after the student passes an evaluation examination.

A medical student who elects to begin graduate work leading to the Ph.D. degree in his senior year of medical school may register in both the Cornell University Medical College and the Graduate School of Medical Sciences. He begins his graduate didactic work during that year, and, ordinarily, the M.D. degree is granted at the end of that year. Research in the area of the Ph.D. thesis topic is begun during the fifth year. A two-year period of full-time research is a realistic minimum estimate for the time required to execute the

experimental and theoretical work necessary to fulfill the requirements for the Ph.D. degree.

(3) Resident Physicians. The resident physician may enroll in the Graduate School of Medical Sciences as a full-time graduate student working toward the Ph.D. Part-time graduate study is not permitted. A maximum of two residence credits for medical school course work in the basic sciences can be granted toward the residence requirements of the Ph.D. degree after the student passes an evaluation examination.

Prospective applicants to these programs should communicate with the associate dean of the Graduate School of Medical Sciences.

# Register of Students

## Doctors of Philosophy

- Augustus C. Damian, Jr., A.A. 1958, Silliman University; M.D. 1963, University of the Philippines; Ph.D. 1969, Cornell University. Major: Physiology. Quezon City, P. I.
- Joseph DiSalvo, B.A. 1966, New York University; Ph.D. 1969, Cornell University. Major: Physiology. Brooklyn, N.Y.
- June Kaiser Dunnick, B.S. 1965, Ph.D. 1969, Cornell University. Major: Microbiology. Locust Valley, N.Y.
- Robert A. Erlandson, B.A. 1959, New York University; M.S. 1963, Long Island University; Ph.D. 1969, Cornell University. Major: Cytology. Woodside, N.Y.
- Anastasia Gregoriades, B.A. 1962, M.A. 1964, Hunter College; Ph.D. 1969, Cornell University. Major: Biology. New York, N.Y.
- Edwin C. Hahn III, B.A. 1958, Amherst College; Ph.D. 1969, Cornell University. Major: Microbiology. Scarsdale, N.Y.
- Ramah La Pushin, B.A. 1959, Barnard College, M.S. 1964, N. Y. U. Graduate School Arts & Science; Ph.D. 1969, Cornell University. Major: Biology. New York, N.Y.
- Arthur Myles, B.A. 1960, Middlebury College; M.A. 1962, Wesleyan University; Ph.D. 1969, Cornell University. Major: Biochemistry. Yonkers, N.Y.
- Priscilla A. Schaffer, B.S. 1964, William Smith College; Ph.D. 1969, Cornell University. Major: Microbiology. Erie, Pa.
- David Soifer, B.S. 1961, Columbia University; Ph.D. 1969, Cornell University. Major: Anatomy. New York, N.Y.
- Sarah S. Winans, B. A. 1963, Ph.D. 1969, Cornell University. Major: Anatomy. Murray Hill, N.J.
- Fran Auerbach, B.S. 1965, Ph.D. 1970, Cornell University. Major: Microbiology. Huntington Station, N.Y.
- Jerald D. Gass, B.S. 1957, University of Oklahoma; M.S. 1962, Harvard University; Ph.D. 1970, Cornell University. Major: Biochemistry. Oklahoma City, Okla.
- Melvin B. Hayes, B.A., 1964, Washington and Jefferson College; Ph.D. 1970, Cornell University. Major: Biochemistry. Dunns Station, Pa.
- Stephen Margolis, B.A. 1963, Yeshiva University; Ph.D. 1970, Cornell University. Major: Pharmacology. New York, N.Y.
- Anne G. Mazelis, B.S. 1962, The College of the City of New York; M.S. 1964, University of Chicago; Ph.D. 1970, Cornell University. Major: Biochemistry. New York, N.Y.
- Peter O. Zelazo, B.A. 1965, Queens College; Ph.D. 1970, Cornell University. Major: Biochemistry. Kew Gardens, N.Y.

## Candidates for the Degree of Doctor of Philosophy

- Jill P. Adler, B.S. 1968, Douglass College. Major: Microbiology. Paterson, N.J.
- Anthony P. Albino, B.A. 1970, Hunter College. Major: Biology. Brooklyn, N.Y.
- Karen Jane Artzt, B.A. 1964, Cornell University. Major: Genetics. New York, N.Y.
- Sr. Mary Frances Asterita, B.A. 1961, Marymount College; M.S. 1969, New York University. Major: Physiology. New York, N.Y.
- Richard William Avenia, B.S. 1967, St. John's University. Major: Biochemistry. Valley Stream, N.Y.
- Michael I. Bernhard, B.S. 1966, Tufts University; M.S. 1969, New York University. Major: Biology. Roslyn Heights, N.Y.
- Lois Bren Bierlmaier, B.A. 1964, Clark University; M.S. 1967, Syracuse University. Major: Microbiology. Mt. Kisco, N.Y.
- William F. Bowers, B.A. 1966, University of California (Berkeley). Major: Biochemistry. Boston, Mass.
- Dorothy L. Buchhagen, B.S. 1966, Columbia University. Major: Biology. New York, N.Y.
- Arthur J. L. Cooper, B.S. 1967, Northern Polytechnic (University of London); M.S. 1968, Imperial College of Science and Technology (London). Major: Biochemistry. London, England
- Victor M. de Leon, B.S. 1961, University of Puerto Rico. Major: Genetics. New York, N.Y.
- Margaret A. Dessau, B.A. 1968, Barnard College. Major: Biology. Far Rockaway, N.Y.
- Khatchik M. Deuvletian, B.S. 1967, M.S. 1969, American University of Beirut. Major: Microbiology. Beirut, Lebanon
- Anna B. Drakontides, B.A. 1955, M.A. 1960, Hunter College; M.S. 1968, Cornell University. Major: Biological Structure. New York, N.Y.
- Annamay T. Duffy, A.A. 1958, Mercy College; B.A. 1959, Manhattanville College; M.S. 1962, Catholic University of America. Major: Biochemistry. Dobbs Ferry, N.Y.
- June C. Dyer, B.S. 1966, McGill University; M.S. 1969, McMaster University. Major: Genetics. Pembroke West, Bermuda
- Edward F. Erker, B.S. 1968, University of Massachusetts. Major: Pharmacology. Walpole, Mass.

- Nancy G. Famulari, B.A. 1968, Colby College. Major: Biochemistry. Nahant, Mass.
- Anthony Ferrara, B.A. 1969, Temple University. Major: Biochemistry. Philadelphia, Pa.
- Lorraine A. Flaherty, B.S. 1967, Jackson College (Tufts University). Major: Genetics. Rutherford, N.J.
- Ellen D. Goldberg, B.A. 1967, Russell Sage College. Major: Genetics. Hillside, N.J.
- William W. Goodhue, Jr., B.S. 1966, Georgetown University; M.D. 1970, Cornell University Medical College. Major: Pathology. Kauai, Hawaii
- Nicola Green, B.A. 1969, Smith College. Major: Microbiology. Wakefield, Mass.
- William E. Hafner, B.A. 1964, University of Rochester; M.A.T. Harvard University. Major: Biochemistry. Roslyn, N.Y.
- Bernard Horowitz, B.S. 1966, University of Chicago. Major: Biochemistry. Philadelphia, Pa.
- Chen-jung Hsu, B.S. 1966 National Taiwan University. Major: Biochemistry. Taipei, Taiwan
- Peter B. Jahrling, B.A. 1967, Cornell University. Major: Microbiology. Ridgewood, N.J.
- Mona D. Jensen, B.S. 1966, Massachusetts Institute of Technology. Major: Microbiology. Muttontown, N.Y.
- Barry B. Kaplan, B.A. 1968, Hofstra University; M.A. 1969, Hofstra University. Major: Biological Structure. Bayside, N.Y.
- Laura D. Kramer, B.A. 1967, University of Pennsylvania. Major: Microbiology. Muttontown, N.Y.
- S. Robert Lehr, B.S. 1966, Polytechnic Institute of Brooklyn. Major: Biophysics. Brooklyn, N.Y.
- Harriet R. Levie, B.A. 1960, Barnard College; M.A. 1964, Hunter College. Major: Biochemistry. New York, N.Y.
- Louise A. Lichtenberg, B.A. 1964, Oberlin College. Major: Biochemistry. Washington, D.C.
- Gesina L. Longenecker, B.S. 1965, Newcomb College. Major: Pharmacology. New Orleans, La.
- Karen M. Lowry, B.S. 1968, Fordham College of Pharmacy. Major: Pharmacology. Stamford, Conn.
- Neal A. Machtiger, B.S. 1966, Cornell University. Major: Microbiology. Valley Stream, N.Y.
- Irvine G. McQuarrie, B.S. 1961, University of Utah; M.D. 1965, Cornell University Medical College. Major: Neurobiology and Behavior. New York, N.Y.
- Patricia L. Morris, B.S. 1969, Molloy Catholic College for Women. Major: Pharmacology. Woodside, N.Y.
- Robert Charles Nowinski, B.S. 1967, Beloit College. Major: Biology. New Rochelle, N.Y.
- Paul V. O'Donnell, B.S. 1968, Rensselaer Polytechnic Institute. Major: Biochemistry. Medway, Mass.
- Paul O. Okonkwo, B.S. 1967, M.S. 1968, Cornell University. Major: Pharmacology. Biafra, West Africa
- Margaret R. Parham, B.S. 1964, Medical College of Virginia, School of Pharmacy. Major: Biochemistry. Richmond, Va.
- Myron Pawliw, B.A. 1968, New York University. Major: Genetics. New York, N.Y.
- Br. Raymund A. Peckauskas, B.A. 1955, Catholic University of America; M.S. 1956, Catholic University of America. Major: Biophysics. New York, N.Y.
- Janet D. Pierce, B.A. 1970, Cornell University. Major: Biochemistry. Baldwin, N.Y.
- Lawrence M. Pinkus, B.A. 1966, The Johns Hopkins University. Major: Biochemistry. Mohegan Lake, N.Y.
- Jeanne Isabelle Rader, B.A. 1966, Syracuse University. Major: Biology. Hamburg, N.Y.
- Noel M. Relyea, B.A. 1968, Cornell University. Major: Biochemistry. Riverside, Ill.
- Paul G. Richman, B.S. 1967, Brooklyn College. Major: Biochemistry. Brooklyn, N.Y.
- Howard C. Rosenberg, B.A. 1969, Ithaca College. Major: Pharmacology. Atlantic City, N.J.
- Robert A. Ross, B.A. 1969, Hobart College. Major: Neurobiology and Behavior. Baltimore, Md.
- Taube P. Rothman, B.A. 1969, Hunter College. Major: Genetics. Dobbs Ferry, N.Y.
- Charles S. Rubin, B.S. 1965, University of Scranton. Major: Biochemistry. Scranton, Pa.
- Meryl S. Rubin, B.S. 1960, The College of the City of New York. Major: Biochemistry. New York, N.Y.
- Charles Seymour III, B.A. 1966, Yale University. Major: Virology. New Haven, Conn.
- Bonnie J. Shubart, B.A. 1968, Wellesley College. Major: Neurobiology and Behavior. Alexandria, Va.
- Janet D. Smith, B.S. 1967, Bucknell University. Major: Biology. Clark, N.J.
- Peter G. Sohnle, B.A. 1966, Rutgers—The State University. Major: Microbiology. Basking Ridge, N.J.
- Roger W. Soller, B.A. 1968, Colby College. Major: Neurobiology and Behavior. Hartsdale, N.Y.
- Marilyn Stephens, B.S. 1962, Marymount College; M.S. 1964, Georgetown University. Major: Biochemistry. New York, N.Y.
- William J. Suling, B.S. 1962, Manhattan College; M.S. 1965, Duquesne University. Major: Microbiology. Bronx, N.Y.
- Laura M. Tarantino, B.S. 1968, College Misericordia. Major: Biochemistry. Exeter, Pa.
- Anne Tax, B.A. 1966, Douglass College, Rutgers—The State University. Major: Microbiology. Linden, N.J.

## 42 Register of Students

- Elizabeth B. Thompson, B.A. 1964, Radcliffe College. Major: Biological Structure. New-ark, N.J.
- Dawn Mei-ching Tsien, B.S. 1968, Cornell University. Major: Biology. New York, N.Y.
- Paul A. VanDerWerf, B.A. 1963, M.S. 1966, University of Minnesota. Major: Biochem-istry. Sandstone, Minn.
- Karl G. Verebely, B.A. 1965, Hunter College; M.A. 1967, The City University of N.Y. Major: Pharmacology. Kew Gardens, N.Y.
- Donald H. Waters, B.S. 1967, Philadelphia College of Pharmacy and Science. Major: Pharmacology. E. Brunswick, N.J.
- Roberta E. Weisbrod, B.S. 1964, Brooklyn College. Major: Biochemistry. Brooklyn, N.Y.
- Jacqueline M. S. Winterkorn, B.A. 1967, Bar-nard College. Major: Neurobiology and Be-havior. New York, N.Y.
- Glenn E. Wotring, B.A. 1966, M.A. 1967, Indiana University. Major: Genetics. Nanu-et, N.Y.
- Tze-Kong Young, B.M. 1960, National De-fense Medical Center. Major: Physiology. Taiwan, China
- Marion M. Zatz, B.A. 1965, Barnard College. Major: Microbiology. New York, N.Y.

## Candidate for the Degree of Master of Science

- Thomas Baker, B.A. 1968, Hunter College. Major: Pharmacology. Bronx, N.Y.
- Miriam G. Fischbach, B.A. 1968, University of Pennsylvania. Major: Biophysics. New York, N.Y.
- Richard R. McCormack, Jr., B.A. 1969, Cor-nell University. Major: Pharmacology. Nut-ley, N.J.

## Students Entering in September 1970

- Alain Amzallag, B.S. 1970, McGill University. Major: Genetics. Montreal, Canada
- Norman R. Boisse, B.S. 1970, University of Connecticut School of Pharmacy. Major: Pharmacology. Old Orchard Beach, Me.
- Barbara A. Brennessel, B.S. 1969, Fordham University. Major: Biochemistry. Brooklyn, N.Y.
- Michael E. Burt, A.B. 1970, Rutgers—The State University. Major: Biochemistry. Belle-ville, N.J.
- Maria T. Caserta, B.A. 1970, Thomas More College, Fordham University. Major: Neuro-biology and Behavior. Woodside, N.Y.
- Ann Jane Feeney, B.A. 1970, Newton Col-lege of the Sacred Heart. Major: Biology. E. Wegmath, Mass.
- Nancy J. Freedman, B.S. 1970, University of Massachusetts. Major: Biochemistry. Chest-nut Hill, Mass.
- David L. Gibbs, B.A. 1970, University of the Pacific. Major: Microbiology. San Francisco, Calif.
- Ellyn J. Glazer, B.A. 1970, Brooklyn College. Major: Pharmacology. Brooklyn, N.Y.
- George R. Henderson, B.S. 1967, St. Law-rence University; M.A. 1970, SUNY at Binghamton. Major: Physiology. Johnson City, N.Y.
- Robert F. Kaiko, B.S. 1970, University of Connecticut School of Pharmacy. Major: Pharmacology. Jewett City, Conn.
- Herbert E. Lowndes, B.A. 1968, M.S. 1970, University of Saskatchewan. Major: Phar-macology. Saskatoon, Saskatchewan, Can-ada.
- Bonnie J. Mathieson, B.S. 1967, University of Illinois; M.S. 1970, Stanford University. Major: Biology. Palo Alto, Calif.
- Lesley A. Radov, B.S. 1970, University of Wisconsin. Major: Microbiology. Erie, Pa.
- Janet E. Rubinstein, B.S. 1970, Tufts Univer-sity. Major: Biology. Portland, Me.
- Michael D. Sapozink, B.S. 1970, Cornell Uni-versity. Major: Biophysics. Rochester, N.Y.
- Rosemary Soave, B.S. 1970, Fordham Uni-versity. Major: Biochemistry. New York, N.Y.
- Meryl G. Steinberg, B.A. 1970, Hofstra Uni-versity. Major: Genetics. East Meadow, N.Y.
- Jeffrey B. Stevens, B.S., M.S. 1970, Michigan State University. Major: Biochemistry. Es-sexville, Mich.
- Linda J. Winsor, B.S. 1970, Michigan State University. Major: Biochemistry. Fanwood, N.J.

# Index

- Admissions, 13
- Biochemistry: Medical College Division, 20;  
Sloan-Kettering Division, 35
- Biological Structure and Cell Biology, 21
- Biology, 36
- Biomathematics, 25
- Biophysics, 37
- Courses: Interdivisional, 34; Medical College  
Division, 20; Sloan-Kettering Division, 35
- Degree requirements, 14
- Examinations, 17
- Facilities: Medical College Division, 12;  
Sloan-Kettering Division, 12
- Faculty, 5
- Financial assistance, 18
- Foreign language requirements, 17
- General Committee of the School, 12
- Genetics, 25
- Grades, 15
- Health service and medical care, 19
- Joint Ph.D. Program in Epidemiology and  
Systems Engineering, 38
- Major and minor subjects, 14
- M.D.—Ph.D. programs, 38
- Microbiology, 27
- Neurobiology and Behavior, 29
- Pathology, 31
- Pharmacology, 32
- Physiology, 33
- Provisional candidates, 14
- Registration, 15
- Residence requirements, 15
- Special Committee, 14
- Special programs, 38
- Students, register of, 40
- Study *in absentia*, 17
- Theses, 18
- Transfer of residence credit, 16
- Tuition and fees, 18